

DOCUMENT RESUME

ED 249 350

CE 039 740

TITLE Tractor & Machinery Safety. 1984 Revision.
INSTITUTION Montana State Office of Public Instruction, Helena.
Dept. of Vocational Education Services.
PUB DATE Jul 84
NOTE 112p.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Accident Prevention; Accidents; *Agricultural Education; *Agricultural Machinery; *Agricultural Safety; Behavioral Objectives; Classroom Techniques; *Equipment Utilization; Learning Activities; Lesson Plans; Safety Education; Secondary Education; State Curriculum Guides; Student Motivation; Teaching Methods; *Tractors; *Vocational Education
IDENTIFIERS Montana

ABSTRACT

This curriculum guide is intended for use in teaching an instructional unit in tractor and machinery safety that is geared toward college freshmen. Addressed in the individual lessons of the unit are the following topics: understanding the importance of safe and efficient tractor operation, understanding the characteristics of tractors, preparing tractors for operation, starting and stopping the tractor, driving a tractor, hitching and unhitching farm implements, and farm-machinery accident situations. Each lesson contains some or all of the following: a statement of need; a suggested reading assignment; objectives; key questions, problems, and concerns along with pertinent teaching techniques and information; suggested learning activities; a list of references; transparency masters; and handouts. (MN)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

TRACTOR & MACHINERY SAFETY

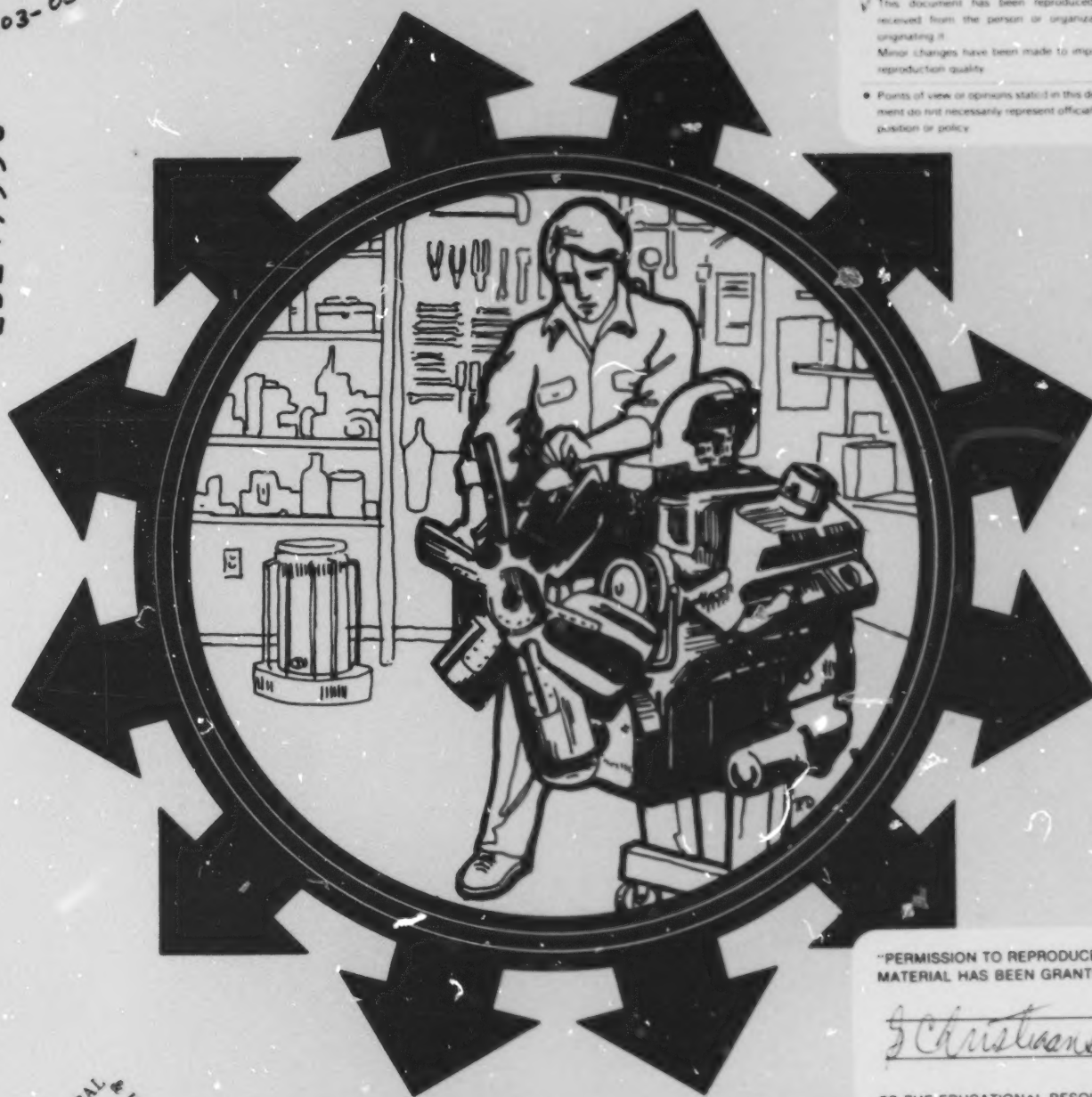
MT 8413307
84-5703-05-23-22-6617

ED249350

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

✓ This document has been reproduced as
received from the person or organization
originating it.
Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official NIE
position or policy.



"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

S. Christensen

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

AGRICULTURAL & INDUSTRIAL
aie
EDUCATION

Agricultural & Industrial Education, Montana State University, Bozeman

1984 Revision

0039740

TRACTOR & MACHINERY SAFETY

The work presented herein was supported
by the Office of Public Instruction
Department of Vocational Education
Services

Montana State University
Department of Agricultural & Industrial Education
Room 126, Cheever Hall, Bozeman, Montana
July, 1984

TABLE OF CONTENTS

<u>Lesson</u>	<u>Page</u>
Understanding the Importance of Safe and Efficient Tractor Operation	3
Understanding the Characteristics of Tractors	23
Preparing Tractors for Operation	30
Starting and Stopping the Tractor	52
Driving a Tractor	64
Hitching and Unhitching Farm Implements	74
Farm Machinery Accident Situations	103

Forward

This unit of instruction has been designed especially for use with freshmen vocational agriculture students. For your convenience, the material has been prepared to fit into a three-ring, loose-leaf notebook. Other material that is prepared to accompany this unit of instruction will be prepared in a similar manner.

The instructor should study the entire unit carefully before attempting to teach any of the lessons. The key concepts that should be presented to meet the objectives of the core curriculum are included; however, all material that would be applicable may not be provided. Each instructor should look for ways to include local examples where possible and appropriate.

Some handouts and visual materials are included with each lesson. Here again, each teacher may have additional illustrative material that would be appropriate. It is also important to have available all references listed at the end of each lesson. The lesson content is based on the references listed.

Special thanks is given to Jim Larson, Vocational Agriculture Instructor, Custer, Montana who prepared the initial material included in this unit of instruction.

UNIT PLAN

UNIT: Tractor and Machinery Safety

Situation:

The tractor and its accompanying machinery are prevalent on all modern farms in Montana. Tractors are becoming more powerful and the machinery is becoming larger and more complicated. Thus, there is more opportunity for accidents, even with the large number of safety devices. Everyone who operates tractors and machinery must have safety instruction before they can be safe operators. This is particularly true in the case of those operators who are less than 16 years of age. There are still too many tractor related accidents in Montana.

Aims and Goals:

1. To help the students understand the importance of safe and efficient tractor operation.
2. To enable the students to start and stop a tractor engine safely.
3. To enable the students to prepare a tractor for operation.
4. To teach the students to start, stop and drive a tractor safely.
5. To teach students to maneuver a tractor safely.
6. To have the students demonstrate their ability to hitch and unhitch equipment properly.
7. To help the students understand how to use the PTO safely.
8. To help the students utilize the hydraulic system safely.

Lessons:

1. Understanding the Importance of Safe and Efficient Tractor Operation
2. Understanding the Characteristics of Tractors
3. Preparing Tractors for Operation
4. Starting and Stopping the Tractor
5. Driving a Tractor
6. Hitching and Unhitching Farm Implements
7. Farm Machinery Accident Situations

Student Activities:

1. Each student will be expected to practice their tractor driving skills.
2. The students will complete assigned worksheets.

3. The students will conduct a tractor-machinery safety check.
4. Conduct a tractor maintenance check.
5. Hitch and unhitch farm machinery.
6. Participate in a tractor driving contest.

Teacher Activities:

1. Order student workbooks and develop instructional material.
2. Arrange for tractors to be used for practice driving.
3. Become familiar with child labor laws regarding tractor driving.
4. Contact highway patrol for material on operating tractors on the highway.
5. Order film material on tractor safety.
6. Arrange for a farm machinery safety check(s).
7. Obtain tractor driving certificates.
8. Gather various owner manuals for tractors and machinery.

Special Equipment:

1. Tractor(s)
2. Audio/visual equipment (Overhead projector)

Evaluation:

1. Safety tests
2. Performance tests
3. Homework assignments
4. Attitude toward safety

References:

- AAVIM, Safe Tractor Operation and Daily Care, American Association For Vocational Instructional Materials, Athens, Georgia, 1981. pp. 119.
- Sillette & Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN, pp. 107.
- John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois
- John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

UNIT: Tractor and Machinery Safety

Lesson: Understanding the Importance of safe and efficient tractor operation

Need:

Although tractors and machinery are being built with operator safety in mind, accidents continue to happen in production agriculture. Many people feel safety reduces tractor and machinery efficiency. Students need to understand that, in the long run, safety will result in a more efficient operation.

Objectives:

1. Given the term "down time", each student will be able to describe how it is the biggest threat to the operation of tractors and farm equipment and discuss the two methods of keeping it to a minimum, and promote safety and efficiency of operation.
2. Upon completion of the lesson, each student will be able to identify the four organizations most concerned with tractor and equipment safety:
 - a. Tractor manufacturers
 - b. National Safety Council (NSC)
 - c. American Society of Agricultural Engineers (ASAE)
 - d. Occupational Safety and Health Administration (OSHA)
3. Given a set of pictures each student will be able to match the correct safe action or unsafe action which describes the picture.
4. After studying the law, each student will identify the minimum requirements of the law required to allow a 14 and 15 year old to be employed as a tractor or machinery operator.
5. Given the 3 areas: SMV's, ROPS, and machinery guarding, each student will be able to identify and describe the importance of each and their application to tractor safety.
6. Upon completion of this unit, each student will be able to identify and discuss the importance of efficient tractor operation including:
 - a. Reducing energy consumption
 - b. Saving fuel costs
 - c. Requiring less labor
 - d. Reducing downtime
 - e. Saving repair bills

Interest Approach:

Provide the students with some of the latest statistics on tractor and machinery accidents. Discuss any local tractor and/or machinery accidents that have occurred recently in your local community.

-
- | | |
|---|--|
| 1. What is "down time"? | <ul style="list-style-type: none">a. There are two types of down time.<ul style="list-style-type: none">1. the operator (see overhead 1)2. tractor or equipmentb. Down time indicates that time when you are not able to operate the equipment or your machine cannot be used for the purpose intended.c. Tractor and equipment down time can be kept to a minimum by operating the tractor and equipment with utmost safety and efficiency. |
| 2. What businesses and organizations are interested in farm tractor and machinery safety? | <ul style="list-style-type: none">a. All companies who manufacture tractors and equipment place safety labels and safety shields on the equipment they build. (overhead 2)b. National Safety Council<ul style="list-style-type: none">1. Provides safety education programs and compiles accident statistics. (overhead 3)2. Show the students the bulletin sent out by the council.c. American Society of Agricultural Engineers (ASAE)<ul style="list-style-type: none">1. Published standards for the design of tractors and implements (overhead 4).d. Occupational Safety and Health Administration (OSHA)<ul style="list-style-type: none">1. Part of the Department of Labor2. Establishes guidelines to assure safe working conditions. |
| 3. What are some hazards that affect safety? | <ul style="list-style-type: none">a. Tractor turnovers (overhead 5)b. Falling from tractors (overhead 6)c. Crushing (overhead 7)d. Being run over by the tractor (overhead 8)e. Highway accidents (overhead 9)f. Getting caught in the power take-off (overhead 10) |

- g. Passengers riding equipment or tractor (overhead 11)
- 4. How can you avoid accidents? (Show overhead 12)
 - a. Be concerned for safety
 - b. Be alert to danger
 - c. Observe conditions which threaten safety
 - d. Take positive action to remedy those conditions.
- 5. What does the law say about safety and employment? (Review handout No. 1, Certificate of Training)
 - a. Fair Labor Standards Act
 - 1. The purpose of this act is to prohibit the employment of children under 16, without special permission, in occupations declared particularly hazardous by the Secretary of Labor.
 - 2. Exceptions to the law
 - a. Handout sheet 1 and discuss in class. (Horbar Student Manual)
- 6. What are three OSHA standards which improve your safety? (Review handout No. 1, Certificate of Training)
 - a. Slow-moving vehicle (SMV) emblems (show students SMV)
 - b. SMV's are required on all vehicles which move 25 mph or less on public roads.
 - c. ROPS (roll over protection structures) (use overhead 13)
 - d. ROPS are required on all tractors of 20 horsepower or more and manufactured after October 25, 1976, if operated by a hired employee.
 - e. Machinery guarding
 - 1. Guards and shields must be in place and warning labels must be visible where needed.
- 7. Efficiency in tractor operation reduces down time.
 - a. Reduces energy consumption
 - b. Saves fuel
 - c. Requires less labor
 - d. Results in less waste
 - e. Saves on repair bills

Application and Followup:

1. Have students complete worksheet #1 out of "Safe Operation of Agricultural Equipment." - Hobar Student Manual
2. Provide owners manuals for each student and one or two tractors to complete Exercise #1.

References:

AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, 120 Engineering Center, Athens, Georgia, 1981.

Silletto and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois

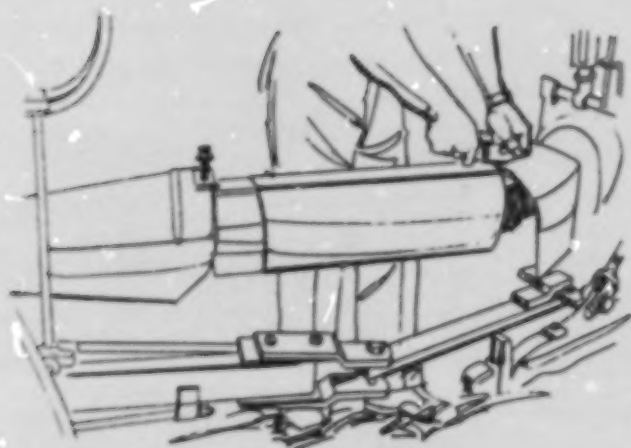
John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

A FARM WORKER ON CRUTCHES HAS LOW EARNING POWER

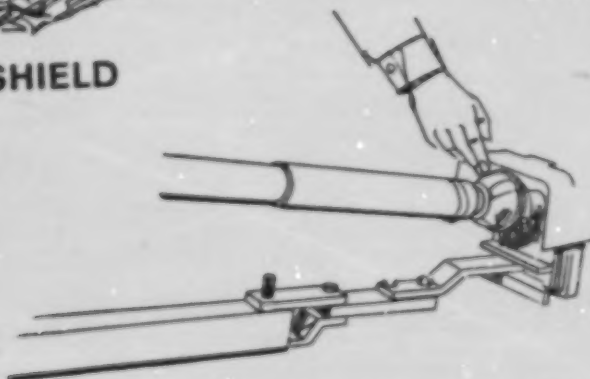


PTO INJURIES & FATALITIES

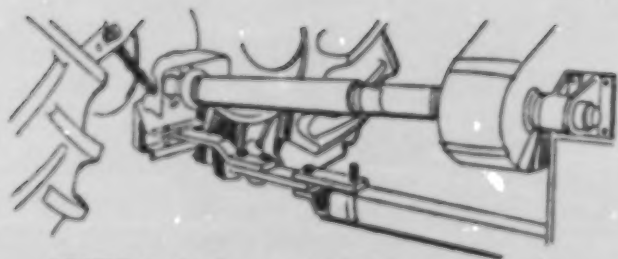
CAN BE PREVENTED BY YOU



PTO TUNNEL SHIELD



FULL SHIELD



INTEGRAL-JOURNAL SHIELD

TABLE I. CAUSES OF FATAL TRACTOR ACCIDENTS
(NATIONAL SAFETY COUNCIL)

ACCIDENT	% OF TOTAL
TRACTOR UPSET	58
FALL FROM TRACTOR	13
CRUSHED (OTHER THAN RUN OVER)	9
RUN OVER	8
MOTOR VEHICLE COLLISION	6
POWER TAKE-OFF (PTO)	3
OTHER	3

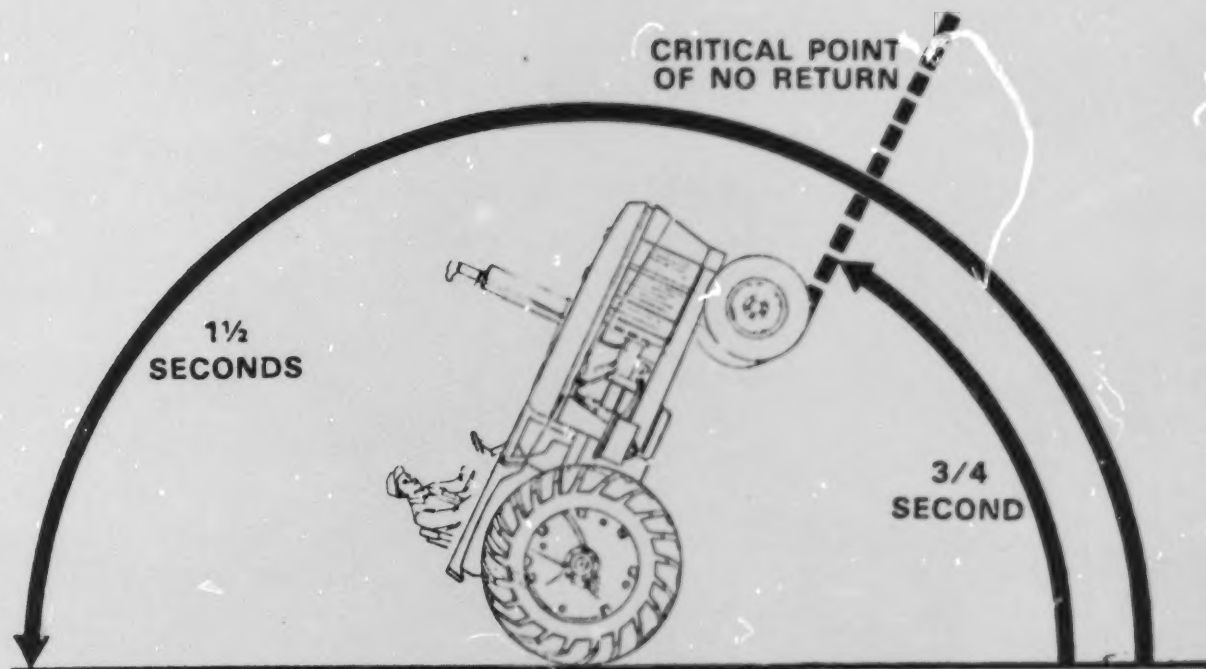
ASAE STANDARD: ASAE S383

ROLL-OVER PROTECTIVE STRUCTURES (ROPS)
FOR WHEELED AGRICULTURAL TRACTORS

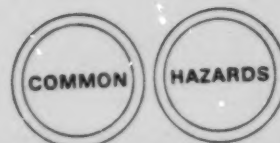
SECTION 1 - PURPOSE

1.1 THE PURPOSE OF THIS STANDARD IS TO ESTABLISH THE TEST AND PERFORMANCE REQUIREMENTS OF A ROLL-OVER PROTECTIVE STRUCTURE (ROPS) DESIGNED FOR WHEEL-TYPE AGRICULTURAL TRACTORS TO MINIMIZE THE FREQUENCY AND SEVERITY OF OPERATOR INJURY FROM ACCIDENTAL UPSETS. ALL SELF-PROPELLED IMPLEMENTS ARE EXCLUDED.

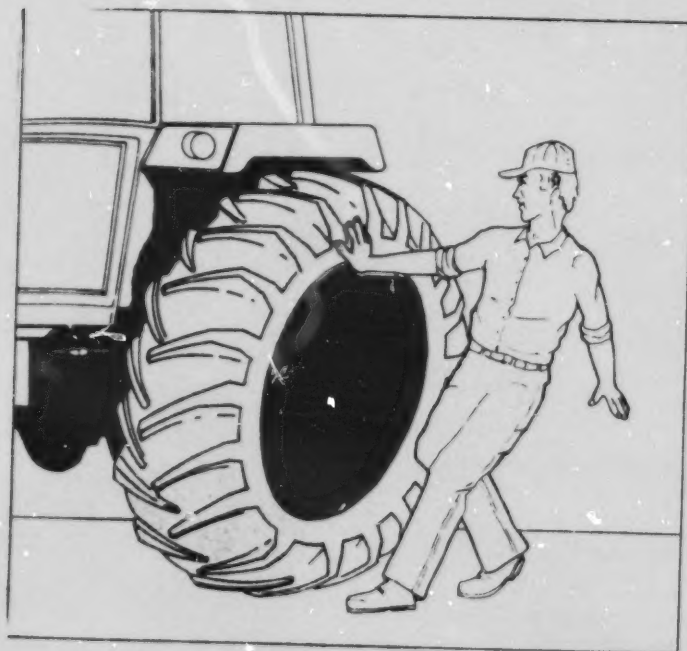
HOW FAST CAN YOU REACT?



SLIP AND FALL

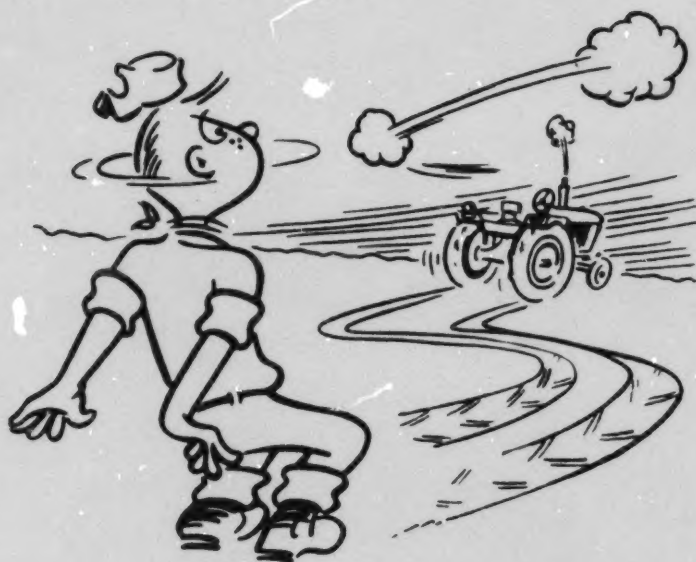


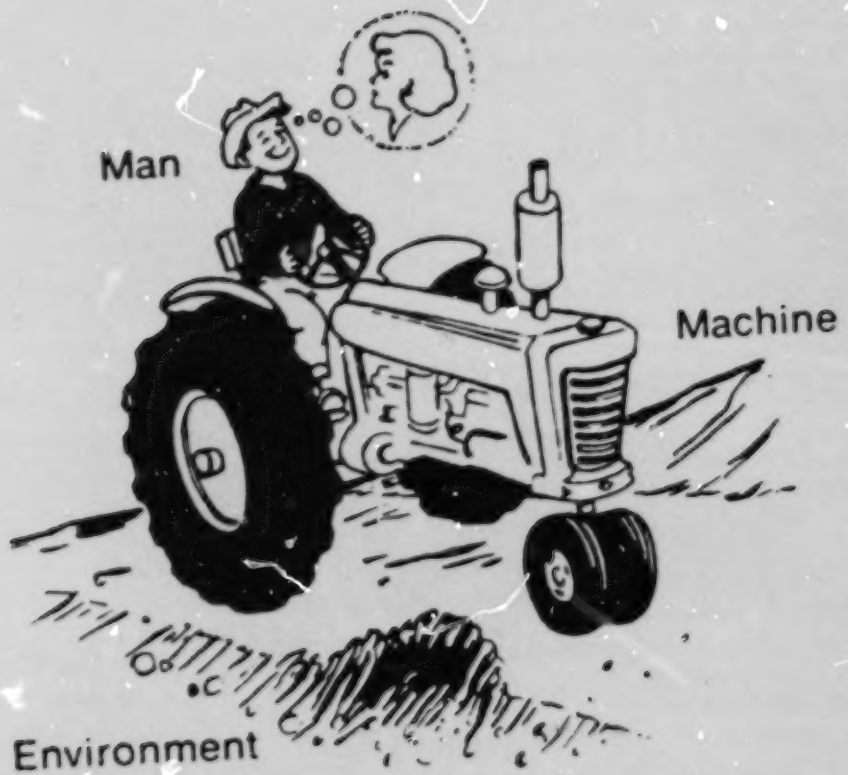
SOME PEOPLE GET HURT
BY ALLOWING A TIRE TO FALL AND CRUSH THEM



CAUTION:

DO NOT PARK TRACTOR IN GEAR WITH KEYS IN SWITCH



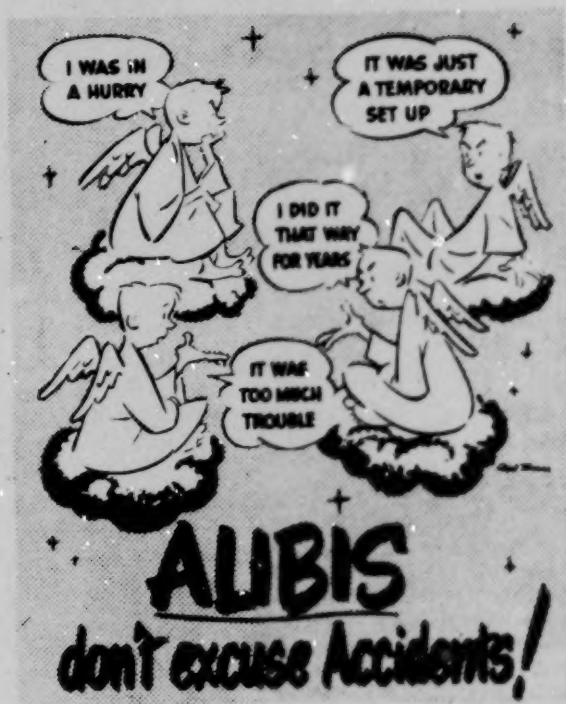


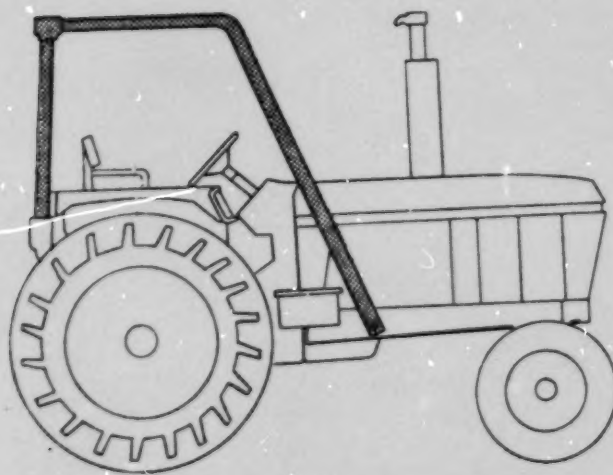
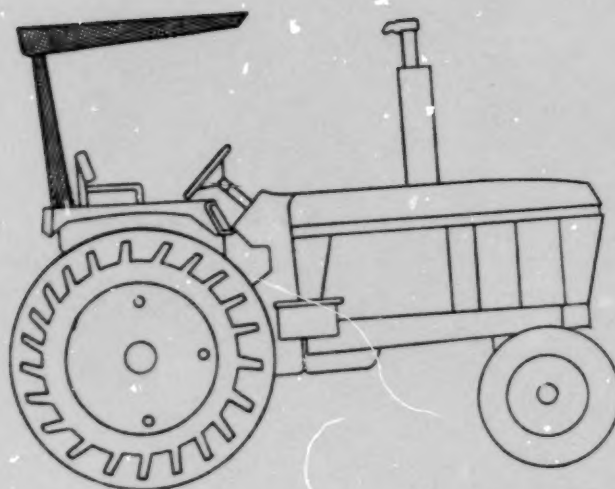
KEEP LOOSE CLOTHING AWAY FROM MOVING PARTS



NO RIDERS







LIMIT MOST UPSETS TO 90° AND PROTECT THE OPERATOR
IF OVERTURN EXCEEDS 90° .

CERTIFICATE OF TRAINING

This is to certify that _____ Certificate No. USDL _____

Name _____ Date _____
(Date of Birth)

Address _____ (Zip Code) _____
is 14 years of age or more and has successfully completed the _____
training program and examinations in _____ (E-1 or V-A)

(Cross out one) 1. Tractor Operation
2. Tractor and Machinery Operation
as specified by the U.S. Department of Labor in the Agricultural Hazardous
Occupations Order (Subpart E-1 of 29 CFR, Part 570) pertaining to the em-
ployment of youth under 16 years of age.
Certifying Authority (Extension Agent or Vocational Agriculture teacher only) _____ Person who conducted the
training program _____

TO THE EMPLOYER

1. The above youth is qualified to be employed as (a) a tractor operator as described in item 1 on the reverse side of this sheet, or (b) as both a tractor and machinery operator as described in items 1 and 2 on the reverse side of this sheet, if certified for both tractor and machinery operation. This certificate is acceptable by the U.S. Department of Labor as proof of training.

U.S. Department of Labor
Employment Standards Administration
Office of Fair Labor Standards

2. The above youth may not be employed in any of the occupations listed in items 3 through 11 described on the reverse side of this sheet.
3. This certificate does not certify training in adjustment of equipment or proficiency in operation, nor does it mean that the holder knows how to safely operate any particular make or model of tractor or machine.
4. It is the responsibility of the employer to instruct the employee on the safe and proper operation of the equipment he is to use.
5. The U.S. Department of Labor requires the employer to "maintain close supervision where feasible, or, where not feasible, in work such as cultivating, the employer or his representative checks on each youth's progress at least midmorning, noon, and midafternoon."
6. Any accident that results in an injury to this person should be reported by the employer to the proper authority including the certifying authority who signed this certificate.
7. This certificate must be kept on file by the employer.

FORM WH-5 (REV. 7-75)

EMPLOYER'S COPY

OCCUPATIONS IN AGRICULTURE PARTICULARLY HAZARDOUS FOR THE EMPLOYMENT OF CHILDREN BELOW THE AGE OF 16

Item (1). Operating a tractor of over 20 PTO horsepower, or connecting or disconnecting an implement or any of its parts to or from such a tractor.

Item (2). Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines:

- (i) Corn picker, cotton picker, grain combine, hay mower, forage harvester, hay baler, potato digger or mobile pea viner;
- (ii) Feed grinder, crop lifter, forage blower, auger conveyor, or the unloading mechanism of a nongravity-type self-loading wagon or trailer; or
- (iii) Power post-hole digger, power post driver, or nonwalking rotary tiller.

Item (3). Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines:

- (i) Trencher or earthmoving equipment;
- (ii) Fork lift;
- (iii) Potato combine; or
- (iv) Power-driven circular, band, or chain saw.

Item (4). Working on a farm in a yard, pen, or stall occupied by a

- (i) Bull, bear, or stud horse maintained for breeding purposes, or

(ii) Sow with suckling pigs, or cow with newborn calf (with umbilical cord present).

Item (5). Felling, bucking, skidding, loading, or unloading timber with butt diameter of more than 6 inches.

Item (6). Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of over 20 feet.

Item (7). Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper.

Item (8). Working inside:

- (i) A fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere;
- (ii) An upright silo within 2 weeks after silage has been added or when a top unloading device is in operating position;
- (iii) A manure pit; or
- (iv) A horizontal silo while operating a tractor for pecking purposes.

Item (9). Handling or applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 135 et seq.) as Category I of toxicity, identified by the word "poison" and the "skull and crossbones" on the label, or Category II of toxicity, identified by the word "warning" on the label.

Item (10). Handling or using a blasting agent, including but not limited to, dynamite, black powder, sensitized ammonium nitrate, blasting caps, and primer cord; or

Item (11). Transporting, transferring, or applying anhydrous ammonia.

GPO 594-377

BEST COPY AVAILABLE

WORKSHEET #1

1. You have read and discussed reasons for learning to be a safe tractor and machinery operator. Sign your name here as a pledge to always do your part to make agriculture a safer place to work.

Signed _____

Signed _____

2. Discuss the important points to remember on page 5 with your parents. Then ask your parents to sign their names and pledge to help you become a safe worker and always to practice safety.

Signed _____

Signed _____

3. During the week, collect accident reports involving tractors and machinery from your local newspapers. For each report, find one or more safety precautions that were not followed.

4. During this course, you will be using tractor operator's manuals occasionally. Begin the use of a tractor operator's manual and complete the following:

a. Make and model of tractor _____

b. Page number of table of contents _____

c. Speed of tractor in fastest gear (look under ground speed or in specifications) _____

d. Are safety precautions listed throughout the manual or grouped on one or more pages? _____

e. What precautions listed in the operator's manual are not in Unit 1 of this manual?

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

(7) _____

(8) _____

(9) _____

(10) _____

5. Select one or more tractors and complete an inspection of the following:

a. Trash or tools on platform?

Yes _____ No _____

b. Fuel system leaks?

Yes _____ No _____

c. Class B fire extinguisher on tractor?

Yes _____ No _____

d. Lights and warning devices clean and functional?

(1) SMV emblem

Yes _____ No _____

(2) Warning lamps

Yes _____ No _____

(3) Headlights

Yes _____ No _____

(4) Taillight

Yes _____ No _____

e. PTO master shield in place?

Yes _____ No _____

f. Is seat loose?

Yes _____ No _____

g. Are tires correctly inflated?

Yes _____ No _____

h. Is the drawbar between 13 and 17 inches above the ground?

Yes _____ No _____

i. Is muffler in good condition?

Yes _____ No _____

j. Is PTO lever in out-of-gear position?

Yes _____ No _____

k. Log chain hanging loose from drawbar?

Yes _____ No _____

5. What other possible safety hazards did you find?

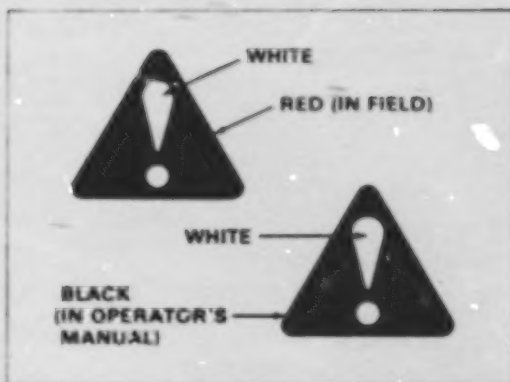
- (1) _____
- (2) _____
- (3) _____
- (4) _____
- (5) _____

6. What hazards did you correct?

- 1. _____
- 2. _____
- 3. _____
- 4. _____



With Dad, read safety rules in your Operator's Manual.



Safety is a family affair. Sign your safety pledge now. (See the worksheet.)

UNIT: Tractor and Machinery Safety

Lesson: Understanding the Characteristics of Tractors

Need:

Safe operators must understand the characteristics of the tractors they are operating. The information about the tractor can be found in the tractor's operating manual. Following the procedures outlined in the operator's manual can extend the life of the tractor and improve the operator's efficiency.

Objectives:

Following the lesson, each student will be able to locate important information in the operator's manual that relates to:

1. Starting and operating procedures
2. Gears and gear selection
3. Service and lubrication specifications
4. Tires and tire maintenance
5. Hydraulic system
6. Using attached equipment
7. Safety precautions to follow

Given pictures of tractor controls or a tractor, each student will be able to identify the controls and describe their purpose.

Following this lesson, each student will be able to identify the functions and proper use of equipment and parts vital to the safe operation of the tractor, and note all special safety requirements.

Interest Approach:

Using a tractor or pictures of the instrument panel, have the students try to identify each instrument and suggest its functions.

Key questions, problems,
concerns

Teaching techniques
and information

-
- | | |
|---|--|
| 1. Why is the operator's manual so important to tractor safety and operation? | a. Manuals are developed by the manufacturer to describe in detail specifications and operating characteristics of the specific tractor or piece of machinery. |
|---|--|

NOTE: Have operator's manuals available for use by students. Have students locate information about the tractor in the manuals provided.

2. What important information can be found in the operator's manual?

a. Manuals will usually:

1. Give power ratings
2. Provide photos of controls and parts
3. Discuss starting procedures
4. Discuss speed and gear selection
5. Provide service and lubrication specifications
6. Recommend tire pressures and give wheel weight specifications
7. Describe operation and precautions to use with hydraulics systems
8. Discusses hitching and unhitching procedures for remote equipment
9. Describes all safety precautions and procedures

3. Do you know instruments and controls? (Use overhead #1A & B)

a. Identify each of the items on overhead 1A, 1B and discuss their functions or use.

b. Using a tractor, let students become familiar with:

1. Brakes and safety lock
2. Fuel gauge
3. Gear selection lever
4. Starter
5. Oil pressure gauge
6. Temperature gauge
7. Ammeter
8. Hour meter
9. Hydraulic lift controls

c. Using the tractor manuals identify each of the following in terms of operation and/or specifications:

1. Tire inflation
2. Wheel weights
3. Type of fuel and oil
4. Seat adjustment
5. Hitch
6. Remote hydraulic hose attachments
7. Radiator cap and coolant
8. Air cleaner
9. Crankcase and dipstick
10. Hydraulic reservoir and dipstick

4. What are the special safety features and requirements?

a. Always look for danger signs such as oil leaks, broken or damaged parts and dirt.

b. Also look for and identify the following on a tractor:

1. Rear view mirror
2. SMV emblem
3. Warning decals
4. ROPS and seat belts
5. Securely fastened tools and equipment
6. First aid kit
7. Fire extinguisher
8. All safety shields in place
9. Good visibility
10. Lights for night operation

Application and Followup:

1. Have students complete Worksheet #1 "Instruments and Controls" (Hobar Publication).
2. Have each student practice on a tractor each of the activities learned in this lesson.

References:

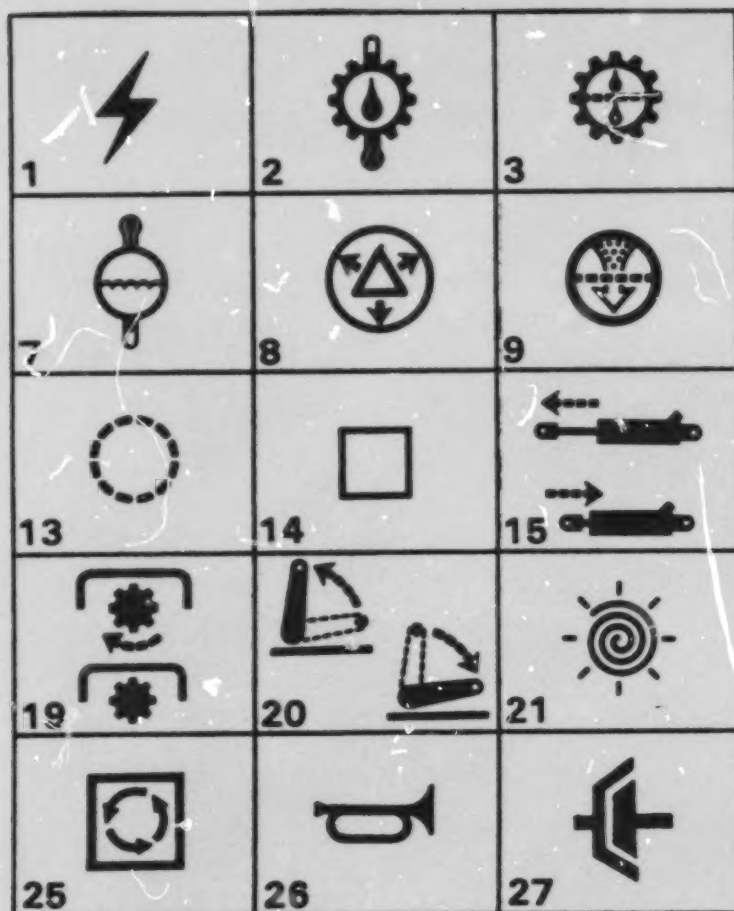
AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.

Silletto and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

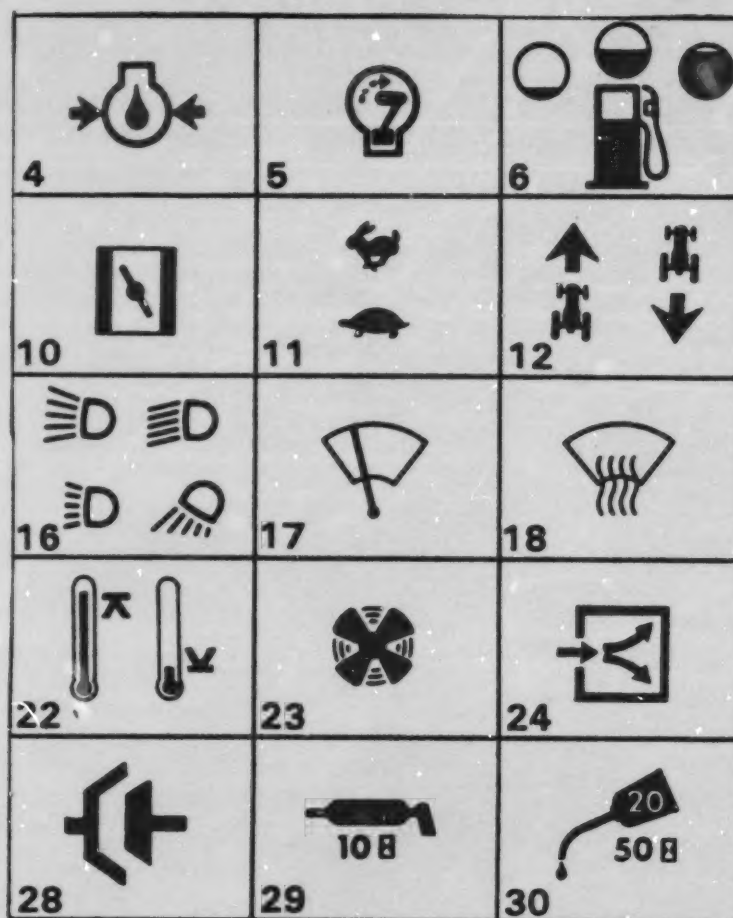
John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois

John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

CAN YOU IDENTIFY WHAT THE
SYMBOL IS TELLING YOU?



CAN YOU IDENTIFY WHAT THE
SYMBOL IS TELLING YOU?



WORKSHEET #1

1. Identify the instrument panel indicators on your tractor.

- | | |
|----------|----------|
| a. _____ | f. _____ |
| b. _____ | g. _____ |
| c. _____ | h. _____ |
| d. _____ | i. _____ |
| e. _____ | j. _____ |

2. Identify the tractor controls indicated by your instructor.

- | | |
|----------|----------|
| a. _____ | f. _____ |
| b. _____ | g. _____ |
| c. _____ | h. _____ |
| d. _____ | i. _____ |
| e. _____ | j. _____ |

3. Questions for discussion.

a. What do gages show that is not shown by indicator lights?

b. Why is normal operating range shown on some temperature gages?

c. Some tractors have a fuel control that is on only when oil pressure is correct.

Is this a good idea? _____

Why? _____

d. What do you think caused the development of standards for tractor controls?

e. What is oversteering of a tractor?

f. How would a tractor with a locked differential respond in a sharp turn?

4. Tractor Inspection. Check a tractor for equipment and respond to items listed.

- | | |
|---|--------------------|
| a. Universal symbols on indicator? | Yes _____ No _____ |
| b. Indicator lights used? | Yes _____ No _____ |
| c. Indicator gages used? | Yes _____ No _____ |
| d. Foot throttle used? | Yes _____ No _____ |
| e. Seated on tractor, can you reach all controls? | Yes _____ No _____ |
| f. Turn signals on tractor? | Yes _____ No _____ |
| g. Parking brake indicator used? | Yes _____ No _____ |

h. Number of seat adjustments?

i. Positions of starter switch?

j. Type of fuel used?

k. Rated engine speed?

l. PTO speed(s)?

m. How many hours has the tractor run?

n. Power steering used?

o. Brakes mechanical or hydraulic?

p. Number of transmission forward and reverse speeds?

Forward _____ Reverse _____

5. List major controls on the tractor and indicate what they do.

Control	Function
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____
f. _____	_____
g. _____	_____
h. _____	_____
i. _____	_____
j. _____	_____

UNIT: Tractor and Machinery Safety

Lesson: Preparing Tractors for Operation

Need:

If a tractor is ready for field work, down time will be greatly reduced. Performing all pre-operation checks will reduce costly repairs and result in more efficient operation plus there will be less likelihood of personal injury.

Objectives:

1. Following the presentation of this lesson, Individual practice and study, each student will be able to thoroughly check and service a tractor according to the standards in the operator's manual.
2. Following this lesson, each student will be able to identify those factors which affect personal safety in the operation of tractors and equipment.

Interest Approach:

Get a pan of extremely dirty oil or air cleaner and show students what can happen if these elements are not maintained properly.

Key questions, problems,
concerns

Teaching technique and
Information

1. Personal Safety

- a. Precautions are extremely important in tractor and equipment operation.

1. Are you mentally alert? - (Show overhead 1)
2. Most accidents are caused because of carelessness. (Show overhead 2)
3. Are you dressed properly? Wear clothes that are comfortable and not baggy. (Show overhead 3)
4. Are you wearing safety equipment when necessary?
 - a. Sight and hearing are precious; protect them when needed.
5. Always be looking for possible hazards. (Show overhead 4)

2. What preparations of the tractor are necessary for safe operation?
(Use a tractor to demonstrate.)

- a. In addition to those procedures already mentioned, preparation of tractor also includes:

1. Providing ventilation when running an engine in a closed building.
2. Check fire extinguishers for condition and location.
3. Read all decals on the tractor.

4. Make sure all shields are in place and working when needed (i.e. PTO)
 5. Clean the mud and grease off all steps.
 6. Check SMV and lights for highway use.
 7. Remove or tie down all loose tools and/or equipment when necessary.
 8. Become familiar with all controls.
 9. Check operator visibility from the cab.
 10. Check all brake operations.
3. What maintenance must be performed to get a tractor ready for operation?
(Use a tractor to demonstrate techniques.)
- a. Check crankcase oil.
 1. Place tractor on level surface.
 2. Apply brakes and stop engine, allow to set for five minutes.
 3. Check oil level. (Discuss proper procedure)
 4. Add oil if needed.
 5. Keep everything as clean as possible.
 6. Do not overfill; it could cause oil foaming.
 - b. Service air cleaners.

There are two types:

 - Oil Bath Air Cleaner
 - Dry Paper Filter Air Cleaner (Show overhead 5 & 6)
 1. Oil Bath

Demonstrate on a tractor; hand out material on "How to Service Air Cleaners." (Handout 1)
 2. Dry Paper Filter Air Cleaners

Hand out material on "How To Service Air Cleaners." (Handout 2)
 3. Servicing the Cooling System

There are two types of cooling systems:

 - Air cooled engine
 - Liquid cooled engine (Show overheads 7 & 8)
 - a. Check the electrolyte level of the battery. The level should be $\frac{3}{8}$ " above the plates. (Show overhead 9)
 - b. If the electrolyte is below the correct level, add clean soft water to cover the plates to the bottom of the filler tubes.
 - c. Clean all cables, terminal and supports and apply a coat of battery terminal spray or coat with grease. (Demonstrate how this should be done.)
 - d. Tighten all battery connections.

- e. Try to keep the positive post covered with a rubber boot to prevent corrosion (negative post if the tractor has a positive grounding system.)
- c. Lubricating the chassis
(Show overheads 10 & 11A & B)
- d. Check with operator's manual for places and procedures.
- e. Demonstrate correct use of grease gun.
 - 1. Wipe end of grease fitting with a clean cloth; keep things clean.
 - 2. Place gun on the fitting and hold directly in line with the fitting.
 - 3. Pump the gun slowly; use no more grease than necessary.
 - 4. Remove gun by swinging through a 30 degree arc.
 - 5. Wipe all excess grease from fitting.
- f. Servicing the Diesel fuel filter system; check with manual or follow these procedures:
 - 1. Check to remove water and sediment at one of the three locations. (Show overhead 12)
 - a. If there is a drain cock:
 - 1. Open and drain about a pint of fuel out - this will remove any moisture.
 - 2. Close drain cock
 - 2. If equipped with water trap and sediment bowl and if bowl is more than 1/3 full of water -
 - a. Close fuel valve under the tank
 - b. Loosen thumb nut under bowl and swing bail to one side
 - c. Remove glass bowl, empty and clean
 - d. Wash the glass bowl in kerosene to remove dirt and sediment
 - e. Install bowl loosely
 - f. Open fuel bowl valve and allow bowl to fill

- g. Tighten thumb nut under bowl when air is completely removed.
- g. Refueling the tractor
The three most important things to remember are:
 - 1. Keep out moisture
 - 2. Keep out dirt
 - 3. Avoid all fire hazards
- h. Proceed with refueling by following owner's manual or:
 - 1. Check against fire hazards
 - a. Shut off engine
 - b. Allow motor to cool down
 - c. Never refuel in a closed building
 - 2. Clean all parts of hoses and containers.
 - 3. Remove dust and loose dirt from fuel tank cap and area around tank opening.
 - 4. Fill fuel tank almost full.
 - a. Allow for expansion.
 - 5. Replace fuel tank cap tightly.

Application and Followup:

- 1. Have students complete worksheets #1 - Maintenance and Safety Checks, and #2 - Tractor Safety on the Farm. Hobar Student Manual.
- 2. Have students practice procedures learned in this lesson using tractors and manuals.

References:

AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.

Silletto and Hull; Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois

John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

OIL-BATH AIR CLEANERS

To service oil-bath cleaners, proceed as follows:

1. Loosen clamp and remove the oil sediment cup from the lower part of the air cleaner (Figure 64 In AAVIM Manual, pg. 27). When dirt level in cup is more than .625 cm (1/4 Inch) deep, pour out the oil and sediment.
2. Clean the Cup with a solvent (Figure 65 In AAVIM Manual, pg. 27).
3. Check air-intake pipe (air stack) for dirt accumulation. This will not need cleaning often, but it is good practice to check it each time the oil cup is serviced. If dirty, swab it out with a clean rag. The more dirt you allow to accumulate in the stack, the more it acts as a choke to air flow which increases fuel consumption.

4. Refill oil cup with new oil to the oil level indicated on the cup (Figure 66, AAVIM Manual, pg. 27). Most operator's manuals recommend that you use the same weight oil as used in the engine crankcase. If you use an oil that is too heavy, the washing action decreases. It also acts as a choke on the engine and increases fuel consumption.

Oil that is too light will be pulled into the engine, lowering the oil level in the cup until the cleaner is not efficient. With diesel engines, the oil will be used as fuel, causing the engine to run wild. When this happens, you have no control of engine speed.

A non-detergent oil may be used which will cause dirt to settle out better.

Do not use old crankcase oil. It may contain unburned fuel which evaporates quickly and lowers the oil level in the cup. It also contains dirt which limits the washing action.

Do not overfill oil cup. On carburetor engines, overfilling increases fuel consumption and causes loss of power. On diesel engines, the oil may be drawn into the engine and used as fuel, causing the engine to run wild.

5. Replace oil cup and tighten clamp.
6. Check air duct between cleaner and carburetor (or intake manifold on diesel engines) for holes or loose clamp connections (Figure 67, AAVIM Manual, pg. 27). Air entering the engine in this manner bypasses the air cleaner. Dirt particles pass directly to the engine, causing rapid wear.
7. Check screened air inlet, or pre-cleaner, and remove trash if necessary. A stiff brush is good for cleaning the screen (Figure 68, AAVIM Manual, pg. 28).

DRY-PAPER FILTER AIR CLEANERS

To service dry-paper air cleaners, proceed as follows:

1. Squeeze dust unloader or check Indicator if supplied on your air cleaner (Figure 69, AAVIM Manual, pg. 28).
The dust unloader is a rubber duck-bill arrangement that is held shut by low vacuum while the engine is running. Squeezing makes certain the valve is working and not blocked by an obstruction.
2. Remove hood or grill, if necessary, to provide access to air cleaner (Figure 70, AAVIM Manual, pg. 28).
3. Wipe off dust accumulated around end of cleaner where element will be removed.
4. Loosen hand screw or clamp that holds the end cup onto the end of the cleaner and remove cup and filter element (Figure 71, AAVIM Manual, pg. 28).
5. Empty cup, wipe out dust, replace or clean filter element and replace cap.
(Procedures for replacing the filter element are given in the publication, TRACTOR MAINTENANCE — PRINCIPLES AND PROCEDURES, AAVIM).

WORKSHEET #1

MAINTENANCE AND SAFETY CHECKS

1. Using a tractor operator's manual, complete the following:

- a. Manual has a maintenance diagram
- b. Manual has a maintenance table
- c. Maintenance guide for tractor when new
- d. Maintenance jobs listed by time interval
- e. List jobs to be completed as required or as needed.

Yes	_____	No	_____
Yes	_____	No	_____
Yes	_____	No	_____
Yes	_____	No	_____

f. List maintenance jobs to be completed according to the time interval listed.

10 hours	50 hours	100 hours	200 hours
----------	----------	-----------	-----------

250 hours	500 hours	1000 hours	Seasonal
-----------	-----------	------------	----------

2. Tractor Check

a. After completing the lists of maintenance items, complete an actual check of a tractor. Check the as required and 10-hour interval group or others as you have time. You may want to make check marks beside the items which need attention.

b. Check a tractor for safety hazards. List what you checked and what problems you found.

Items

Hazards found

WORKSHEET #2

TRACTOR SAFETY ON THE FARM

1. Refer to the list of safety precautions at the end of Unit 1. Select at least one safety rule, also called precautions, from each of the groups and explain how a tractor operator's attitude about safety would be important and directly related to that precaution. You may write a brief description and your explanation about the precautions in the space provided.

a. Maintenance and adjustment

b. Motion

c. Implement

d. Power takeoff

2. Carelessness and improper use of tractors have been suggested as being important causes of tractor accidents. Do you agree with this? _____ Refer to the accident reports you have collected.

How were carelessness and improper use of tractors or machinery involved in those accidents which occurred on farms? How many items under "Summary of Tractor Safety" in this unit apply to accident reports you have collected?

3. Explain how you think the accidents could have been prevented.

4. Housekeeping around the farm was listed as a way of reducing accidents.

a. What accident in your community was probably caused by poor housekeeping?

b. Inspect your home farm for poor housekeeping or other safety hazards. List the hazards and how you think they could best be eliminated. After you have completed the list, discuss it with your parents. Check each hazard as it is corrected.

Area	Hazard	How hazards could be eliminated
------	--------	---------------------------------

Roadway and drives		
--------------------------	--	--

Shop and machine storage		
--------------------------------	--	--

Fuel storage		
-----------------	--	--

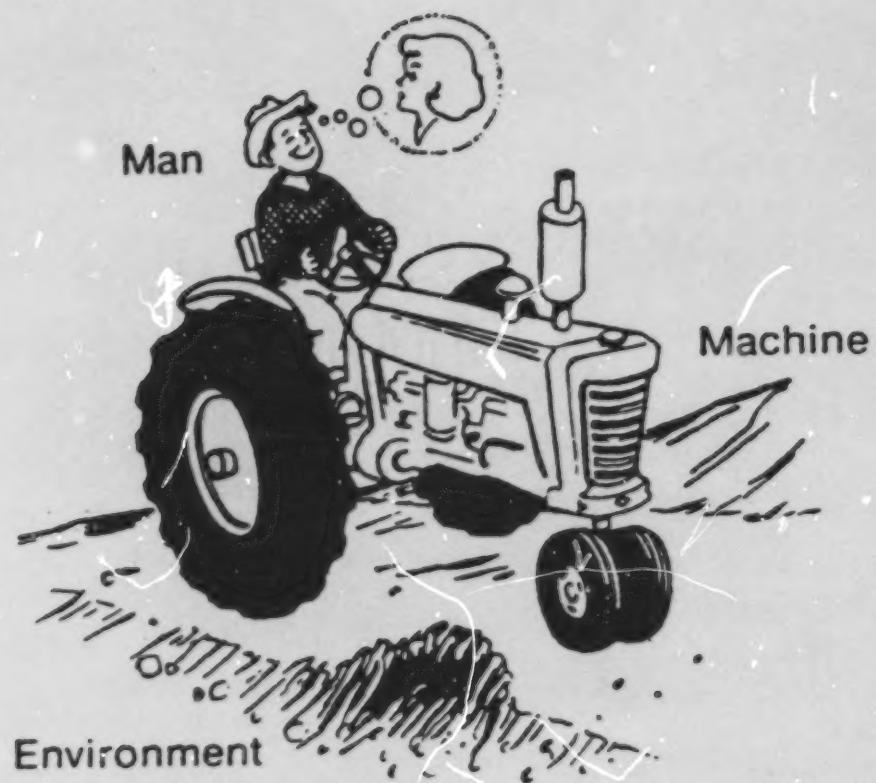
Farmstead and buildings		
-------------------------------	--	--

Fields		
--------	--	--

5. Check here if your tractor will now pass a safety inspection. _____

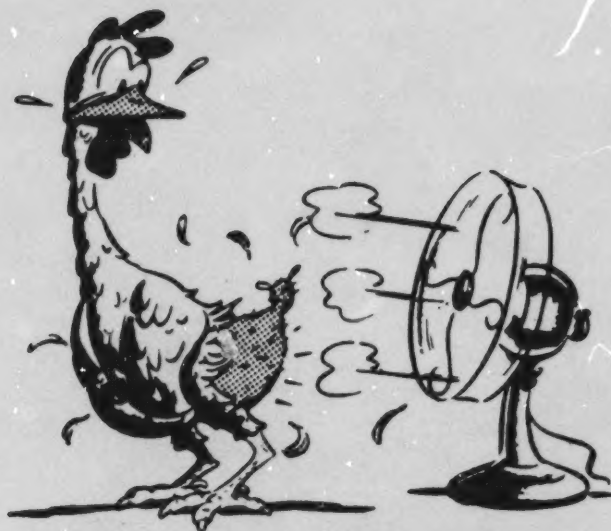
YOU MUST BE MENTALLY ALERT





KEEP LOOSE CLOTHING AWAY FROM MOVING PARTS

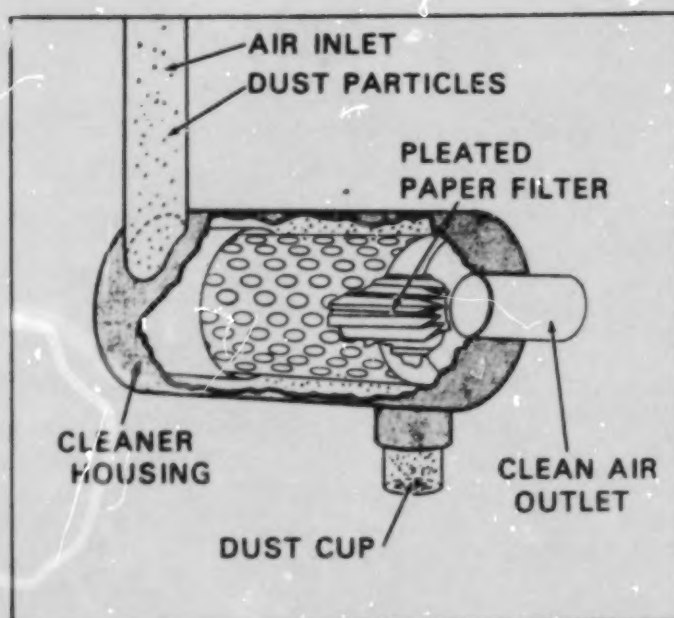




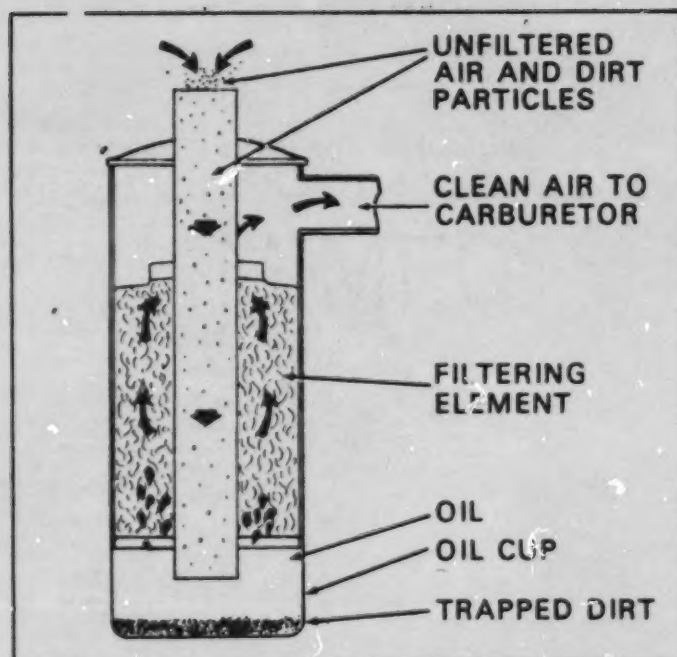
Be Extra Cautious
around Moving Machinery!

R 3330

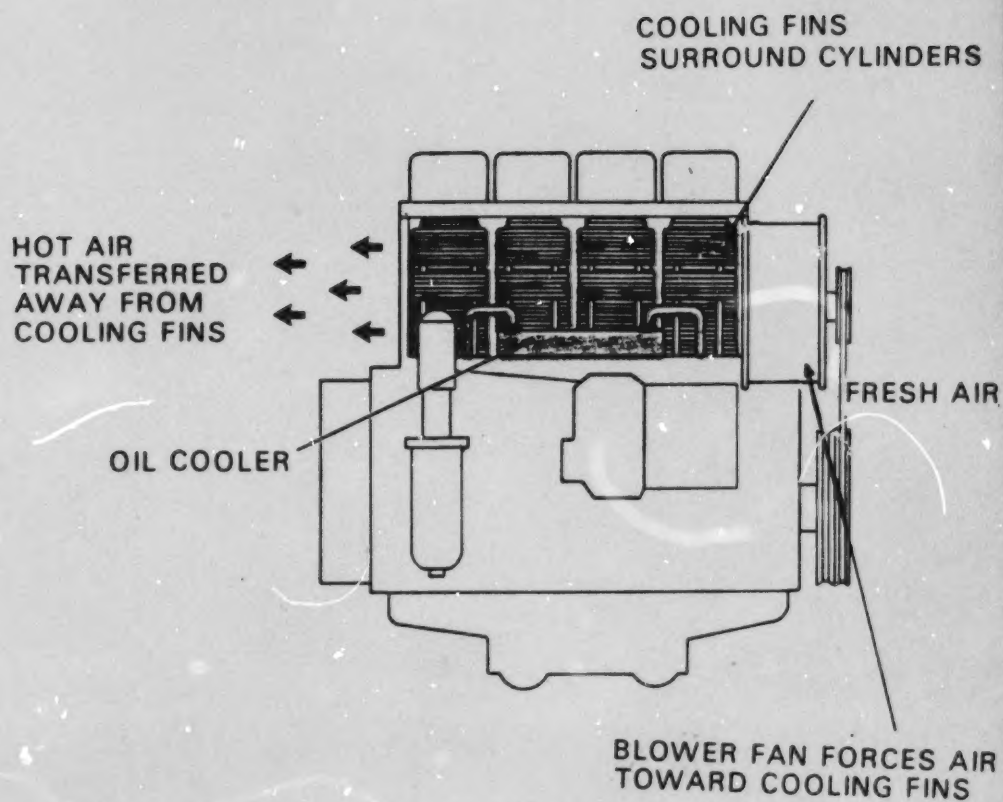
PRINCIPLE OF DRY-PAPER FILTER AIR CLEANERS



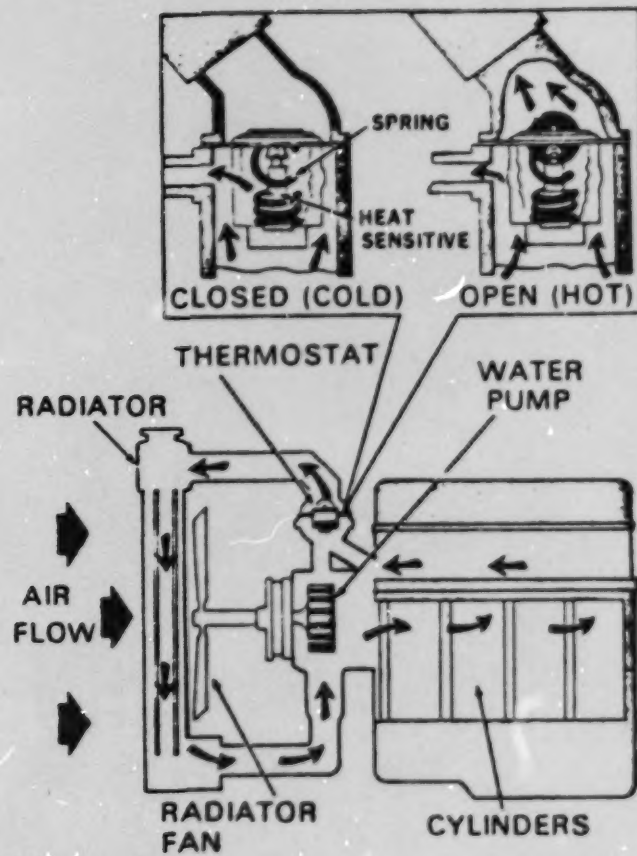
PRINCIPLE OF AN OIL-BATH AIR CLEANER



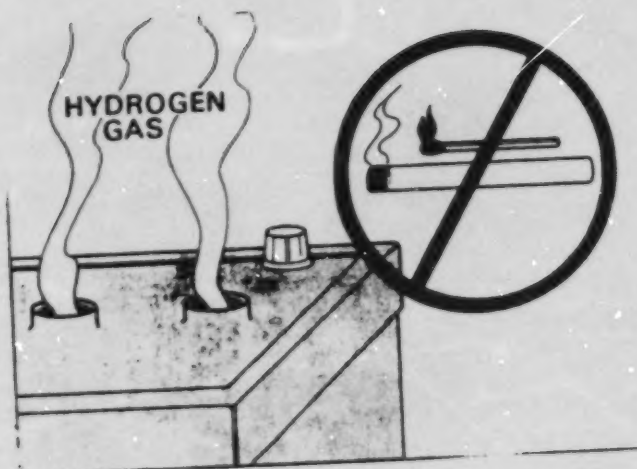
HIGH VELOCITY AIR IS DIRECTED OVER THE COOLING FINS
TO TRANSFER HEAT AWAY FROM THE CYLINDERS



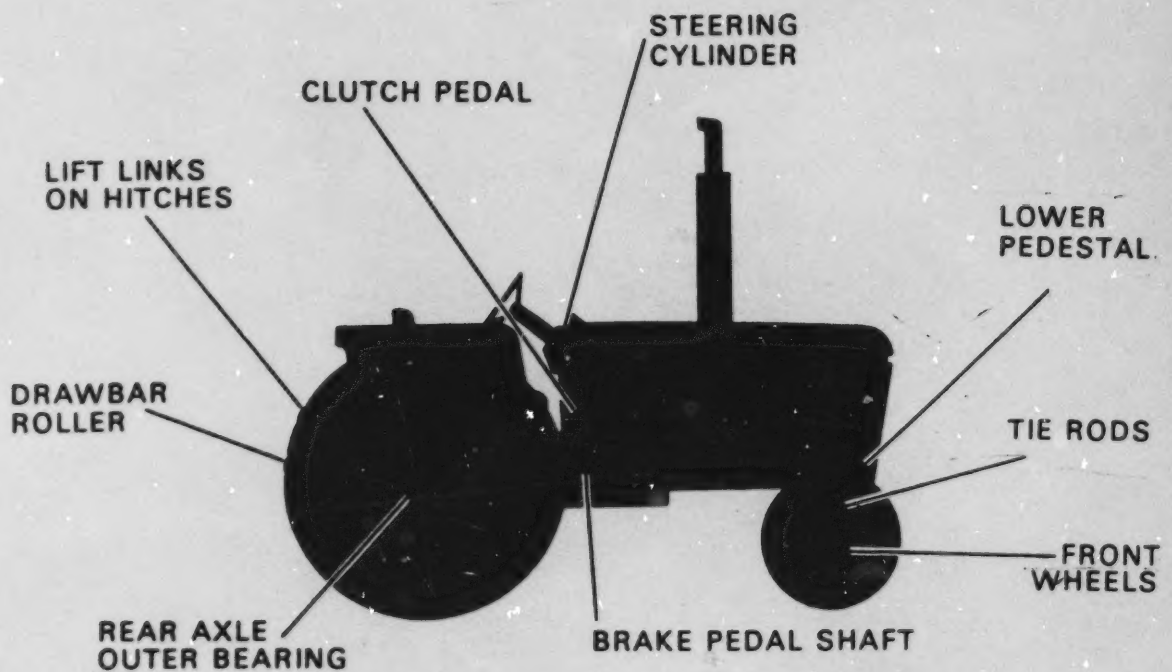
LIQUID COOLING SYSTEM



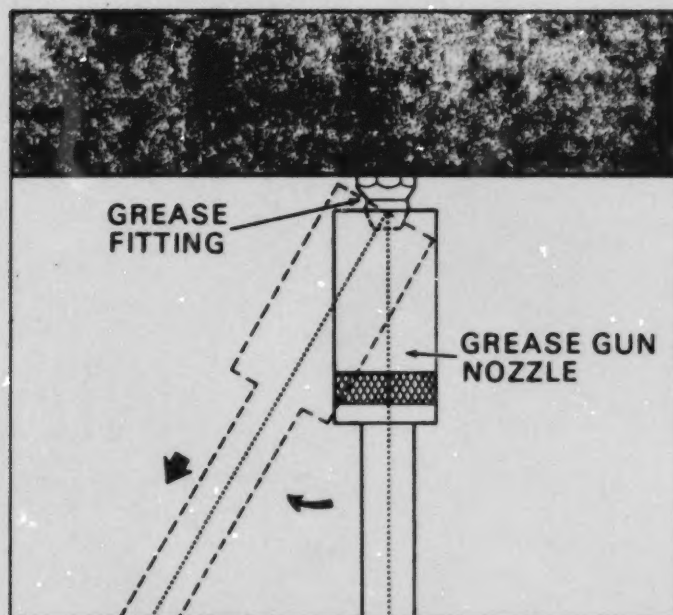
NEVER SMOKE OR LIGHT A MATCH NEAR
A BATTERY WHILE CAPS ARE REMOVED



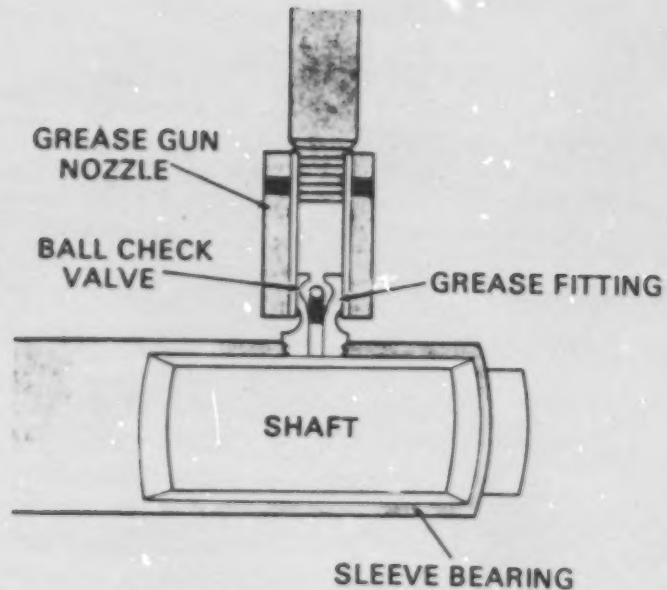
EXAMPLES OF GREASE-FITTING LOCATIONS ON TRACTORS



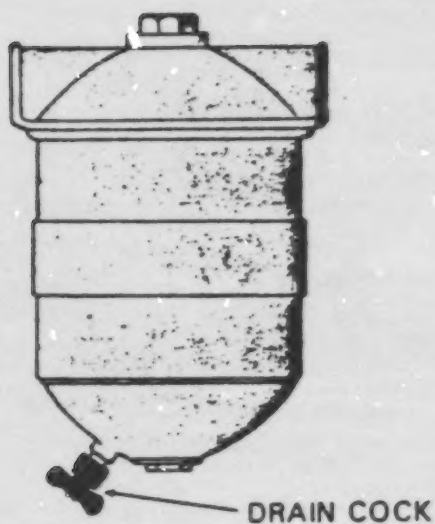
**TO REMOVE GREASE GUN,
SWING THE GUN AWAY
FROM THE GREASE FITTING
IN A 30 DEGREE ARC.**



PRESSURE FROM GUN FORCES GREASE
PAST BALL CHECK VALVE TO BEARING SURFACE.
WHEN GUN IS REMOVED, THE VALVE CLOSSES TO KEEP OUT DIRT.



FUEL FILTER EQUIPPED WITH DRAIN COCK



UNIT: Tractor and Machinery Safety

Lesson: Starting and Stopping the Tractor

Need:

Different types of internal combustion engines are started and stopped in different ways. Properly starting and stopping an engine can reduce engine wear and prolong the life of the engine. Not only will the life of the engine be extended but maintenance costs will also be reduced.

Objectives:

1. Given two tractors, or pieces of self-propelled equipment, each student will be able to identify them as gasoline or diesel and start and stop each tractor or machine engine correctly and with efficiency.

Interest Approach:

Have students identify (with or without the aid of tractor engines) the differences between gas and diesel tractors and engines.

Key questions, problems,
concerns

Teaching techniques and
information

-
- | | |
|--|--|
| 1. What are the differences between gasoline and diesel engines? | a. Show overheads 1A,B-2A,B,3, 4A,B <ol style="list-style-type: none">1. Gasoline engines have spark plugs, carburetors, distributors and ignition coils.2. Diesel engines have fuel injectors and injector pump. |
| | b. Operation <ol style="list-style-type: none">1. Gasoline engines draw a gasoline and air mixture into the cylinders which is ignited by a spark produced by the spark plug.2. Diesel engines have diesel fuel injected into the air compressed inside the cylinder. Compression ignites the fuel. |
| 2. Starting a gasoline engine. | a. Use a tractor to demonstrate all the steps. <ol style="list-style-type: none">1. Clear the area of all objects or obstructions.2. Get on tractor - never start engine from anyplace but the tractor seat.3. Make sure shift lever is in neutral or park. |

4. Set speed control (throttle) lever to desired position as indicated by operation manual.
 5. Disengage clutch.
 6. Set choke at desired position (only when engine is cold).
 7. Turn Ignition - Switch to "on" position.
 8. Crank engine (in accordance with the operation manual).
 9. After engine starts, release foot clutch slowly.
 10. Check oil pressure gauge or warning light.
 11. Adjust the choke for smooth operation.
 12. Adjust throttle to moderately fast idling speed (especially in cold weather).
 13. Watch Indicator to determine when engine is warmed enough to be put to use.
3. Stopping a gasoline engine.
- a. If engine has been heavily loaded, allow it to idle at about 1/2 throttle for two or three minutes.
 - b. Retard throttle and turn off ignition switch - never choke an engine to stop it. That leaves excess fuel in the cylinder which washes the oil off the walls and dilutes the oil.
 - c. If the tractor is to remain idle overnight or longer, shut off fuel valve under the tank.
4. Starting the diesel engine.
- a. Set all controls and clutches according to operator's manual.
 - b. Turn on the fuel supply. Sometimes this is part of the throttle and on some tractors this is a separate control.
 - c. Turn starter switch to "on" position.
 - d. For cold weather starting, use the provisions on your tractor for easy starting.
 - e. Crank engine several revolutions; then open from 1/2 to completely open while cranking. Limit all starting operations to 15 or 20 seconds each time.

- f. Allow engine to warm up properly according to operator's manual before putting tractor or machine into operation.
- 5. Stopping a diesel engine.
 - a. If engine has been operated on heavy load, let it idle at 1/2 throttle or faster for three or four minutes.
 - b. Completely retard the throttle.
 - c. Turn off the fuel supply.

Application and Followup:

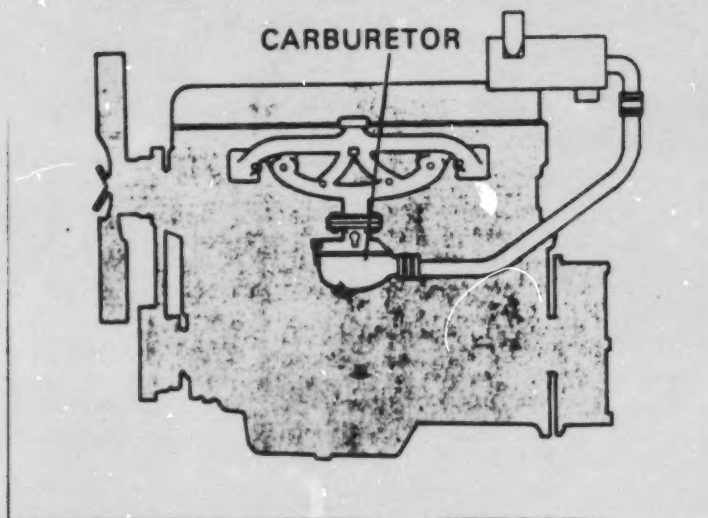
1. Have students complete worksheet #1 - Starting and Stopping Tractors. Hobar Student Manual.
2. Review all procedures on a gas and a diesel tractor or self-propelled equipment.

References:

- AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.
- Sillette and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.
- John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois
- John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline Illinois

CARBURETOR

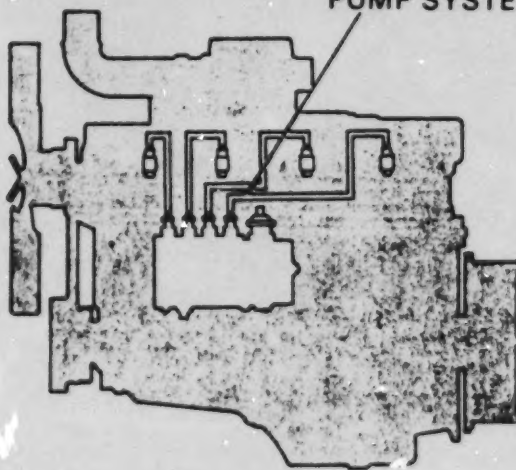
GASOLINE
L-P GAS



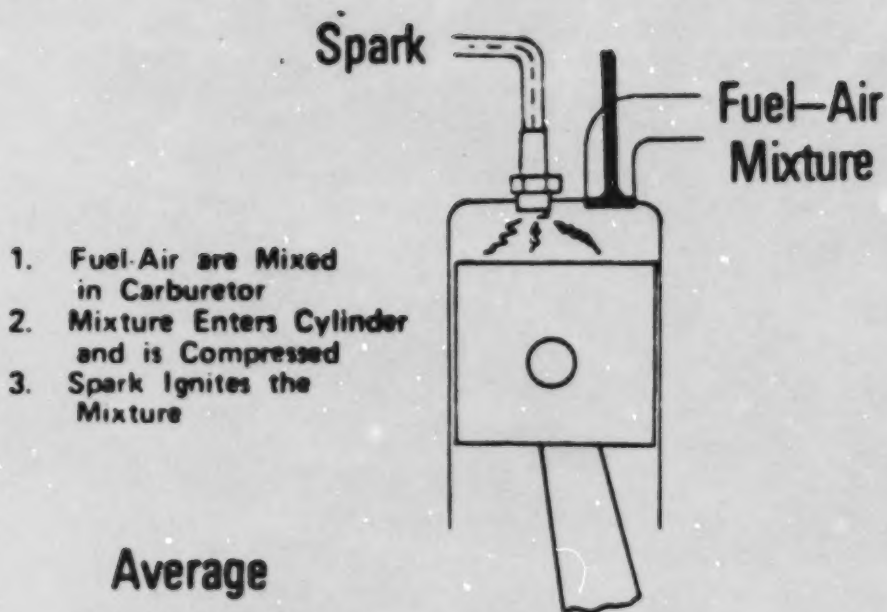
DIESEL

DIESEL FUEL

FUEL-INJECTION
PUMP SYSTEM



GASOLINE COMBUSTION CYCLE

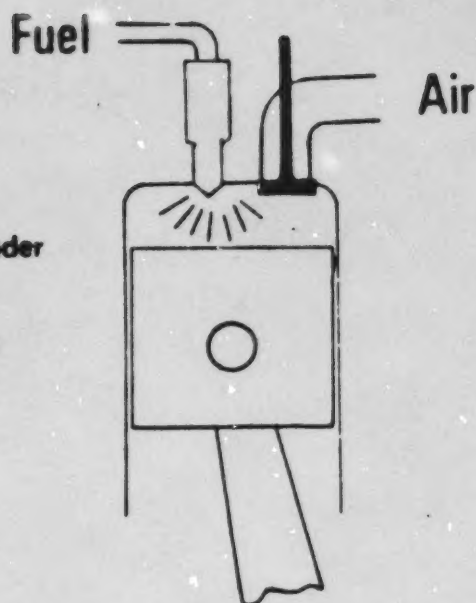


**Average
Compression
Ratio:
8 to 1**

Gasoline

DIESEL COMBUSTION CYCLE

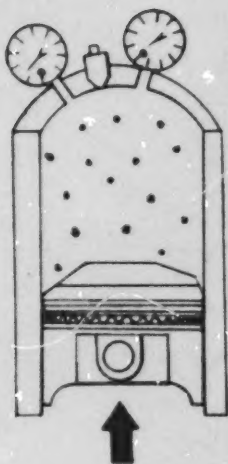
1. Air Only Enters Cylinder
2. Air is Compressed
3. Fuel is Sprayed in
4. Fuel-Air Ignites from Heat of Compression



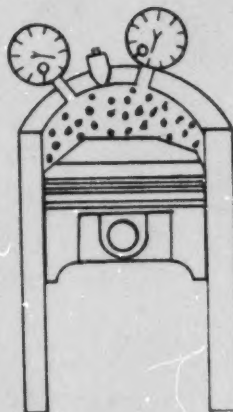
Average
Compression
Ratio:
16 to 1

Diesel

DIESEL ENGINE COMBUSTION



Piston moves up
on compression
stroke



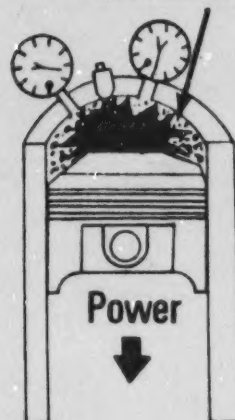
Air is trapped in
the cylinder
causing pressure
to rise

Injection of Fuel



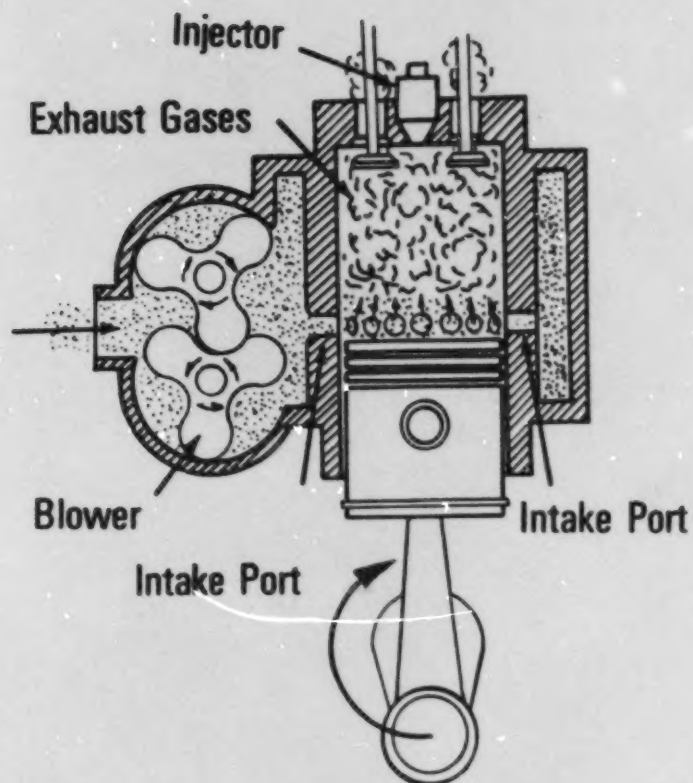
Piston reaches
TDC and fuel is
injected into the
cylinder

Combustion

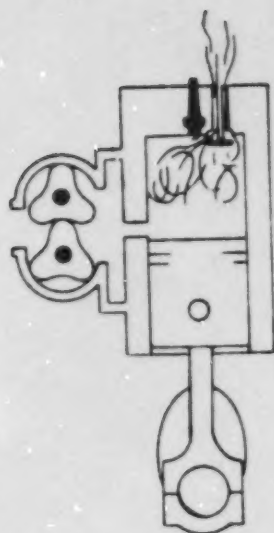


Hot compressed
air ignites the fuel,
combustion occurs,
and this creates
energy to force the
piston down on
the power stroke

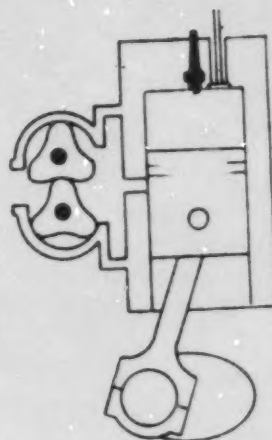
TWO STROKE CYCLE OPERATION



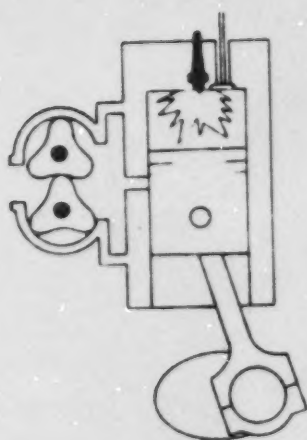
TWO STROKE CYCLE OPERATION



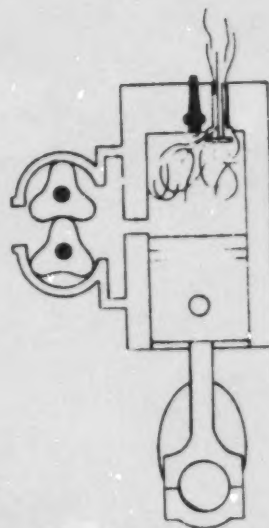
Intake



Compression



Power



Exhaust

WORKSHEET #1

STARTING AND STOPPING TRACTORS

1. Refer to an operator's manual and answer the following.

- | | |
|--|--------------------|
| a. Manual is for gasoline engine only. | Yes _____ No _____ |
| b. Manual includes gasoline and diesel. | Yes _____ No _____ |
| c. Starter switch button used. | Yes _____ No _____ |
| d. Starting fluid adapter is on tractor. | Yes _____ No _____ |
| e. Ether starting fluid recommended (if diesel). | Yes _____ No _____ |
| f. Engine is equipped with thermostat bypass for fast warm-up. | Yes _____ No _____ |
| g. Tractor may be pushed or pulled to start if battery fails. | Yes _____ No _____ |
| h. If gasoline engine is included, engine should be choked for starting when warm. | Yes _____ No _____ |
| i. Engine rpm recommended for warm-up. | _____ |
| j. How is fuel shut off (diesel)? | _____ |
| k. Length of time recommended for starter use (seconds). | _____ |
| l. Throttle position recommended for start | _____ |
| m. Is an electric engine coolant heater an accessory or standard equipment? | _____ |
| n. Time recommended for engine to idle before stopping after a heavy pull (minutes). | _____ |

2. How should a gasoline tractor engine be stopped if the engine continues to *diesel* after the ignition key is turned off? _____

3. List the procedure recommended for starting the tractor.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

4. List the procedure recommended for stopping the engine.

- _____
- _____
- _____
- _____
- _____
- _____

- g. _____
- h. _____
- i. _____
- j. _____

5. What are the recommendations for engine warm-up? _____

UNIT: Tractor and Machinery Safety

Lesson: Driving a Tractor

Need:

Driving a tractor can be fun if you know your tractor and follow good tractor driving rules. Every year, people are killed when they try to take shortcuts or become careless. A "show-off" has no place behind the wheel of a tractor.

Objectives:

1. Upon completion of this lesson and appropriate practice, each student will be able to start and stop tractor movement and drive the tractor safely. This includes driving the tractor forward and backward and maneuvering it around obstacles.
2. Given the basic hand signals which direct motion, each student will be able to complete the action required from a tractor seat.
3. Given a tractor, each student will be able to describe all the necessary safety precautions to be followed when driving a tractor.

Interest Approach:

Set out a driving course and demonstrate what each student will have to do to pass the course or have a highway patrol officer come in and discuss traffic laws involving tractors and equipment.

Key questions, problems,
concerns

Teaching techniques and
information

- | | |
|--------------------------|---|
| 1. Providing for safety. | <ol style="list-style-type: none">a. Be sure you are in good physical condition.b. Study your operator's manual before driving the tractor (know your tractor).c. Learn the basic hand signals.<ol style="list-style-type: none">1. Show overhead 1.2. Have 2 or 3 students demonstrate each of the signals.3. Have students practice these signals.d. Check to make sure all guards and shields are in place.e. Fasten your seat belt if your tractor has a ROPS.f. Check to make sure area is clear of unnecessary obstacles, i.e. people, animals, other equipment. |
|--------------------------|---|

- g. Never allow others to ride on tractors or trailing equipment.
 - h. Never operate a tractor from anyplace but the seat.
 - i. Observe all traffic safety rules.
 1. Discuss laws concerning traffic flow.
2. Starting tractor movement.
- a. Adjust engine speed according to operator's manual.
 - b. Lock the individual brake pedals together.
 - c. Disengage parking brake latch.
 - d. Disengage the clutch and depress the foot brake. (Show overhead 2)
 1. Discuss functions of the clutch.
 - e. If equipped with different speed ranges, select the one wanted.
 - f. Move the gear shift lever to the desired gear selection. (Show overhead 3A,B)
 - g. Release the foot brake and engage the clutch slowly.
 - h. Gradually open the throttle to desired speed.
 - i. Shift gears when necessary.
3. Stopping the tractor movement.
- a. Start preparing to stop far in advance and look for possible hazards.
 - b. Avoid sudden stops whenever possible.
 - c. Disengage clutch simultaneously with throttle reduction and application of brakes.
 - d. Move gear shift lever to neutral or park.
 - e. Re-engage the clutch.
 - f. Lock foot brakes or shift transmission to park.

4. Maneuvering the tractor.

- g. Before dismounting, allow all moving parts to stop and make sure tractor cannot move.
- a. Always watch ahead to make sure there are no hidden obstacles when going forward.
- b. When backing, be aware of what's behind you, what's ahead of you, and what's around you.
- c. When turning:
 - 1. Reduce speed
 - 2. Look in all directions
 - 3. Signal if operating in an area that would require it
 - 4. Make the turn only when the way is clear

5. Driving on streets and highways.

- a. Always take care when entering the highways.
 - 1. Look for vehicles
 - 2. Always signal
- b. Adjust the travel speed to meet the situation.
- c. Allow traffic to pass if it builds up behind you.
 - 1. Review Montana law.

6. Driving on rough ground.

- a. The most important thing to do is reduce speed and be extremely alert to all hazards and obstructions.

7. Getting out of a mud hole.

- a. Try to back out all mud holes first before attempting other methods.
- b. If all else fails, dig out in front and back of wheels and proceed very slowly with extreme caution. (Show overhead 4)

8. Preventing overturns.

- a. Fasten your seat belt if your tractor is equipped with ROPS.
- b. Try to stay clear of all ditches, embankments, and ponds.
- c. Always watch for possible hazards and adjust your speed according to the conditions.

9. Operating on slopes.

- a. Try to avoid slopes.
- b. When tractor begins to tip, turn the steering down the slope. (Show overhead 5)
- c. On extremely steep slopes back the tractor up the slope. When going downhill always leave tractor in gear.
- d. Always reduce speed according to the conditions.

Application and Followup:

1. Have students complete unit 6 worksheet - Tractor Safety on the Road. Hobar Student Manual.
2. Using a tractor have students complete a driving course designed to give them those competencies needed for tractor operation in forward and reverse direction.

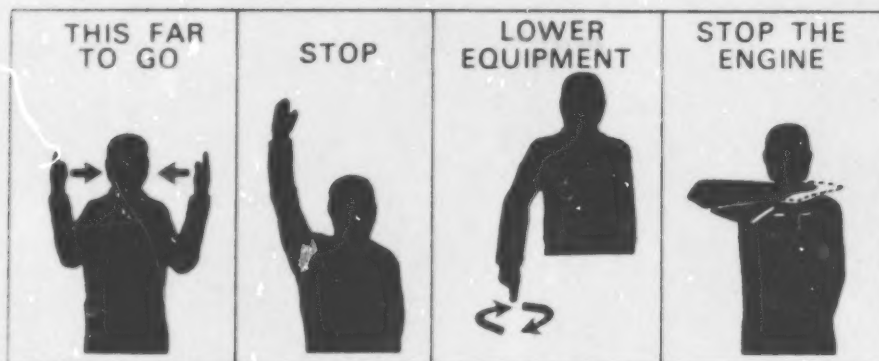
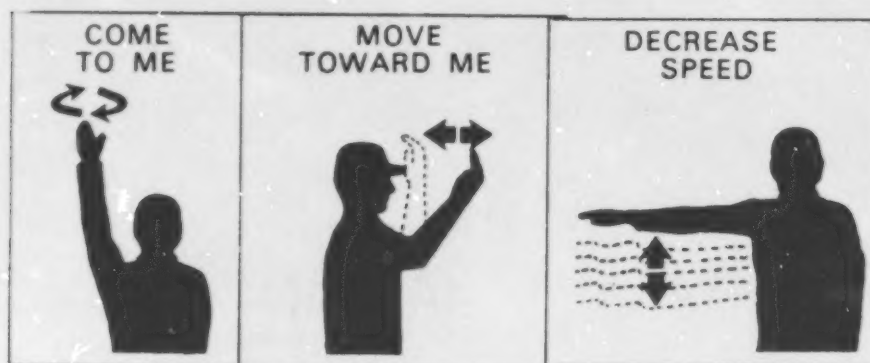
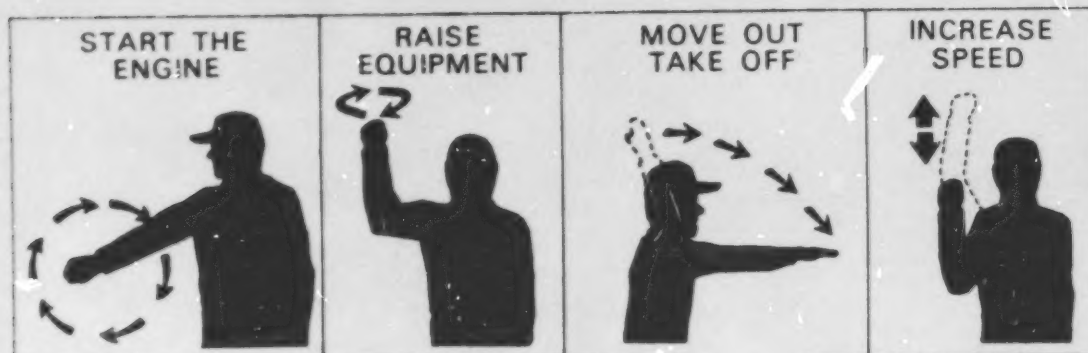
References:

AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.

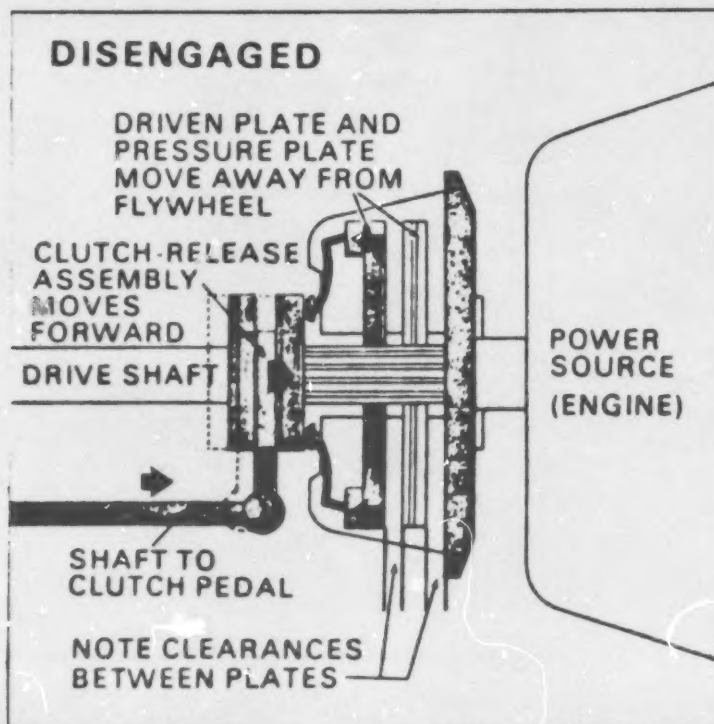
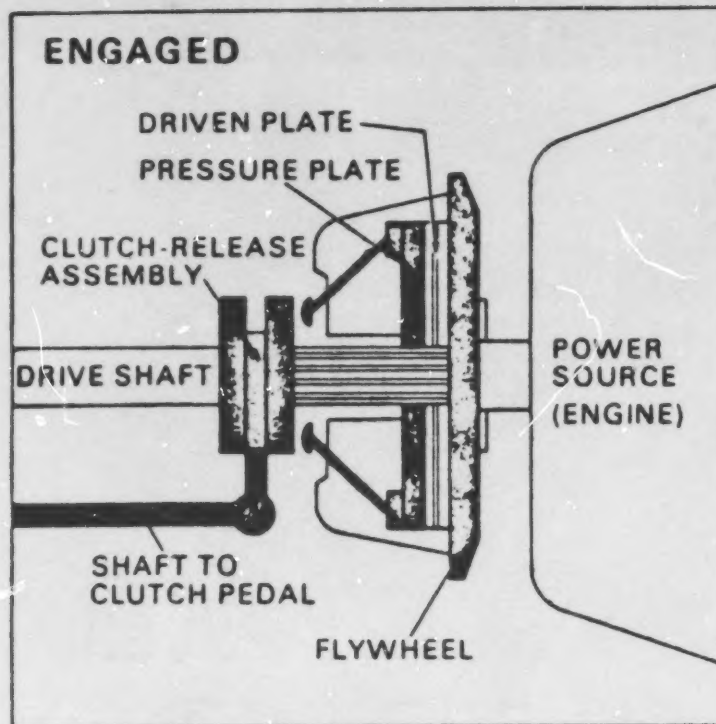
Silletto and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

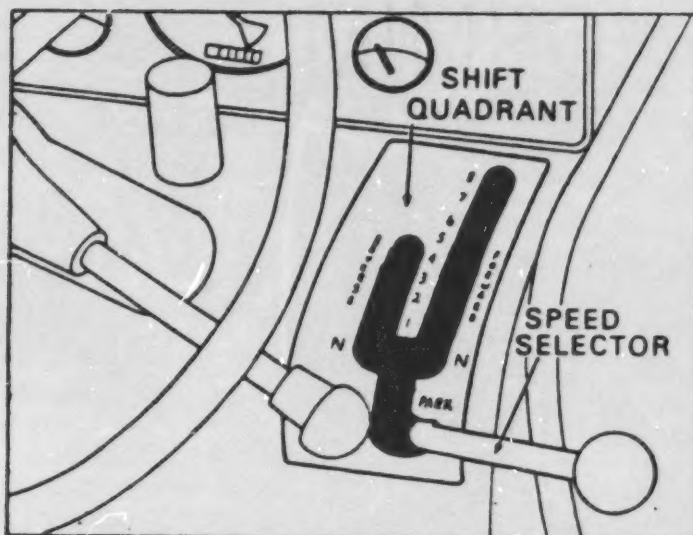
John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline Illinois

John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline Illinois



CLUTCH OPERATING PRINCIPLE





Power-assist shift transmissions show the speed selections in regular sequence.

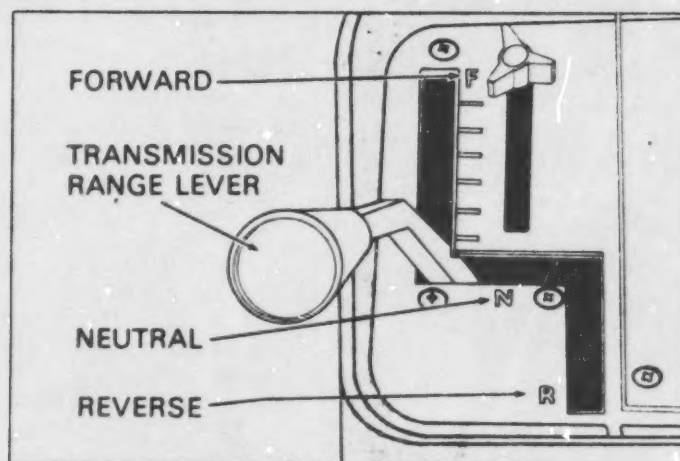


FIGURE 178. Hydrostatic transmissions have no "steps" in speed range selections.

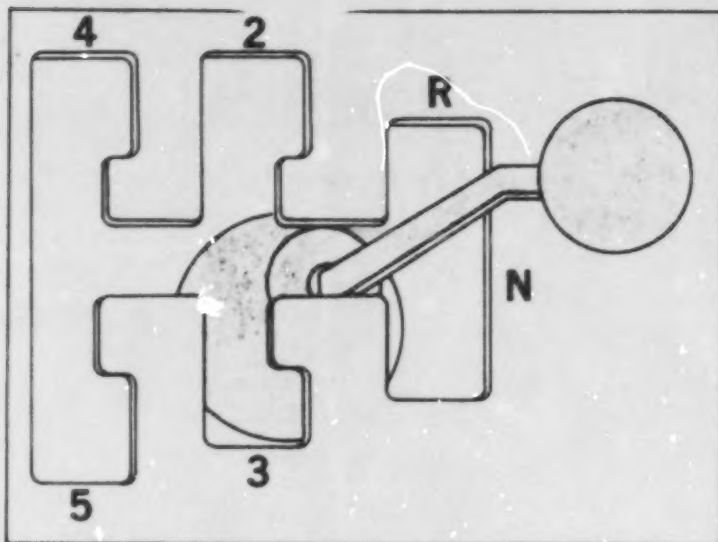
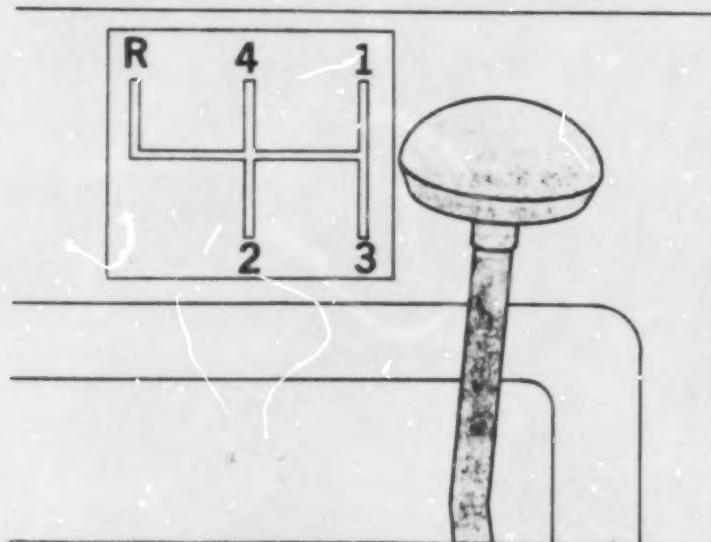


FIGURE 179. Hand-shifted transmissions may have a lever that works within the various slots and notches of a quadrant to provide forward or reverse movement or a



lever which is positioned in accordance with a label showing gear positions.

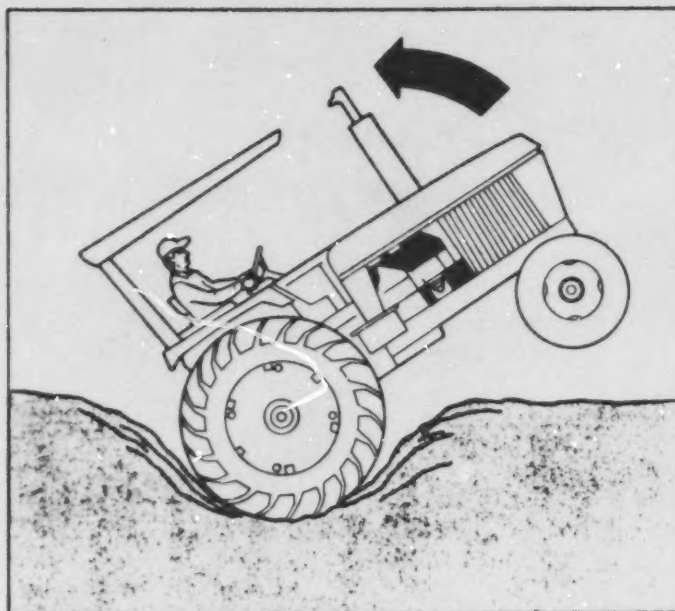


FIGURE 202. The tractor may tip backward when being driven out of a ditch.

NOTE! Cross ditches where banks have a gradual slope—or don't cross them!

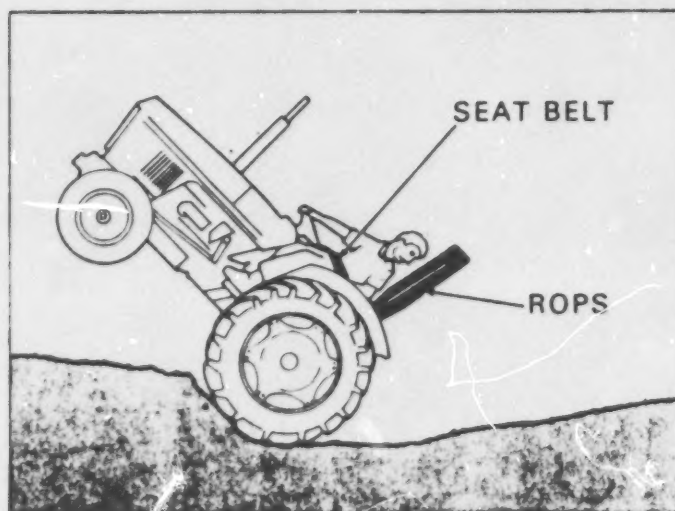


FIGURE 203. Roll bars and seat belts in use prevent many overturns from becoming fatal accidents.

HOW DO YOU REDUCE CHANCES
OF SIDEWAYS OVERTURNS?



UNIT: Tractor and Machinery Safety

Lesson: Hitching and Unhitching Farm Implements

Need:

To function correctly, farm implements must be attached to the tractor in a proper manner. Proper hitching is particularly important when the implement is powered through the PTO of the tractor. Tremendous stresses can be placed on either the tractor or implement if improperly attached.

Objectives:

1. Given a tractor and a variety of farm implements, each student will be able to make implement to tractor hookups in an efficient and safe manner.
2. Following this lesson and individual practice, each student will be able to discuss the safety factors involved with hookup and unhitching of farm implements to a) drawbars, b) power take-off equipment, c) remote hydraulic equipment, d) belt driven equipment and hang-on equipment.

Interest Approach:

Describe some unusual situations for the students which would involve hitching or attaching a piece of equipment to a tractor. Have them describe how they would accomplish the task safely. One could also set up an actual situation with a tractor and implement and have the students describe what they would do.

Key questions, problems,
concerns

Teaching techniques and
information

-
- | | |
|--|--|
| 1. Attaching equipment to the drawbar. | a. Always follow the procedure described in the operations manual. |
| | b. Depending on the type of drawbar, adjust it to a height about 15" from the ground. <ol style="list-style-type: none">1. The ASAE has established 13" to 17" as a hitch height standard. (show overhead 1) |
| | c. Check drawbar length; there are generally two positions: <ol style="list-style-type: none">1. Close hitch for pulling equipment2. Extended hitch for pulling those pieces of equipment connected to PTO for power. (Show overheads 2A,B and 3) |
| | d. When hitching to PTO shafts using 540 RPM, the hitch point must be 14" from the end of the PTO shaft. |

- e. For PTO operating at 1,000 RPM, the hitch point must be 16" from the end of the PTO shaft.
 - f. In some cases, drawbar extensions might be necessary to make equipment work efficiently.
 - g. Check lateral position of drawbars (side motion)
 - 1. For disking, harrowing, and pulling heavy loads of most kinds, let the drawbar swing freely. (Show overhead 4)
 - 2. For PTO equipment, center the drawbar hitch point directly under the PTO shaft and fasten it securely.
 - h. Back your tractor into position so the drawbar hole is in line with hitch of implement.
 - i. Set and lock your tractor brakes to prevent movement of the tractor when you are not on the seat of the tractor.
 - j. Attach implement to drawbar, never try to operate tractor or move it from the ground.
 - k. After connecting to drawbar, make electrical connections and PTO connections when necessary.
 - a. Rear-mounted equipment is accomplished by one of three types of hitches:
 - 1. Single point hitch
 - 2. Two point hitch
 - 3. Three point hitch (Show overhead 5)
 - b. There are 4 categories of implements designed for the standard three-point hitch.
2. Hitching rear-mounted equipment.

Category	Max HP
1	20 to 45
2	40 to 100
3	80 to 225
4	180 to 400

- c. Show overhead 6 and discuss the differences in the categories.

- d. Attaching a 3-point hitch:
(Show overheads 7 and 8A,8)

1. Make sure drawbar will not interfere with movement of hitch.
2. Back up tractor so lower links are in position for connecting to implement hitch pins.
3. Raise or lower hitch with hydraulic control to height needed to connect to implement hitch pins.
4. Put transmission selection lever in neutral or park.
5. Attach lower limbs to hitch pins of implements.
6. Now attach upper link to implement mast.
7. Add sway bars or stabilizer bars if necessary.
8. Raise equipment from the seat of the tractor, not from the ground -- recheck all connections.

3. Connecting PTO shafts.

- a. There are two types of shafts as established by ASAE.
1. Original standard of 540 RPM accepted in 1938.
 2. The second standard of 1,000 RPM accepted in 1958 - this one was developed for greater PTO efficiency and meet the needs of higher speed machinery.
- b. The standards provide that shafts shall be splined differently. (Show overhead 9)
- c. Besides having 2 PTO speeds there are also 3 types of PTO drives.
1. Transmission driven PTO. PTO is directly attached to transmission when clutch is depressed to stop ground movement, PTO also stops. (Show overhead 10)
 2. Independent PTO. PTO runs regardless of tractor clutch operation. (Show overhead 11 and 12)
- d. Always check with operator's manual first.
1. Set wheel brakes
 2. Disengage power to PTO shaft
 3. Shut off engine (this is a good precaution)
 4. Determine shaft type and speed on tractor and implement

5. Check inside of spline of implement shaft for dirt or foreign matter. Remove any which appears.
 6. Clean and oil outside spline of tractor PTO shaft.
 7. If the Implement shaft is a separable type, check to assure typical operation will not separate shafts and that both ends are put together correctly. (Show overhead 13 & 14)
 8. Slide universal joint securely into position on PTO shaft. (Show overhead 15)
 9. Check connections by pulling firmly on drive shaft assembly.
 10. Check alignment of PTO shaft assembly to make certain hitch point is centered between universal joints.
 11. Attach and check all safety shields. (Show overhead 16)
 12. Engage PTO and operate slowly to ensure correct operation.
4. Connecting equipment with remote cylinders.
- a) Types of cylinders
 1. Single action type which puts pressure in one direction only. (Show overhead 17)
 2. Double action type which puts pressure in two directions.
 - b. ASAE standards categorize cylinders
 1. Category 1 - up to 45 HP with 8" stroke
 2. Category 2 - 40-100 HP with 8" stroke
 3. Category 3 - Over 80 HP with 8" or 16" stroke
 - c. Pressures vary from tractor to tractor - from 700 psi. to 3000 psi.
 1. Determine type of cylinder and make sure cylinder is locked into place. (Show overhead 18) Also determine type of tractor hydraulic system and if it is compatible with the rest of the hydraulic system.
 2. Remove dust plugs and discuss their importance. (Show overhead 19)
- b) Connecting hoses

3. Relieve the pressure in the tractor lines.
 - a. After engine is turned off, work control lever back and forth.
4. Clean connections and attach the couplings. (Show overhead 20)
5. Operate hydraulic equipment and check carefully for proper operation.
5. Unhitching hydraulic equipment.
 - a. Place Implement where it will remain stable after it is unhitched.
 - b. Disconnect hydraulic equipment first.
 - c. Now disconnect PTO shaft and then unhitch implement leaving it in a position for easy hook-up. (Show overhead 21)

Application and Followup:

1. Have students complete worksheet#1- Tractor Hitches, PTO and Hydraulics. Hobar Student Manual.
2. Demonstrate and have students practice hitching and unhitching equipment to a tractor.

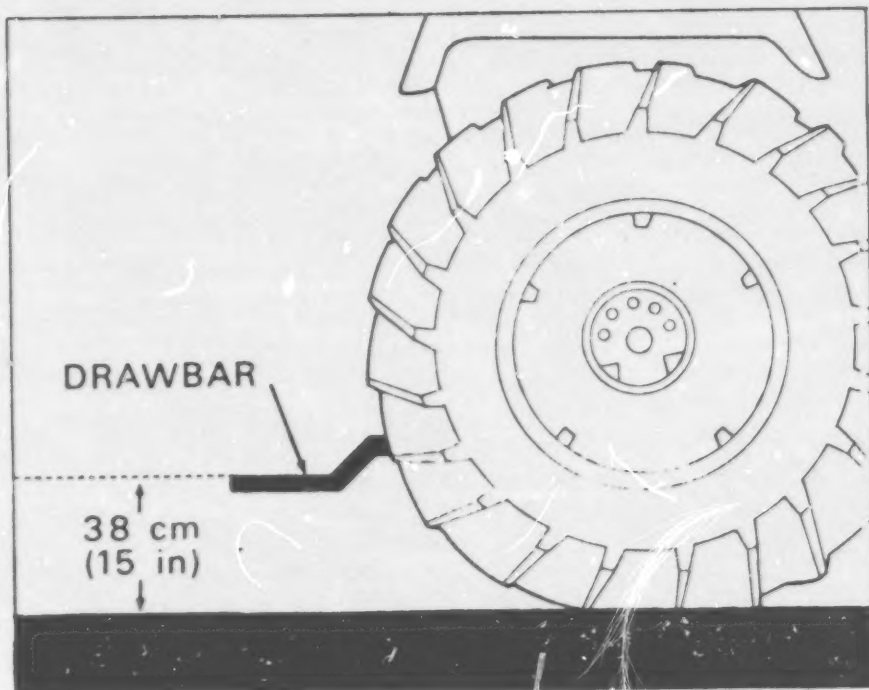
References:

AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.

Sillette and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

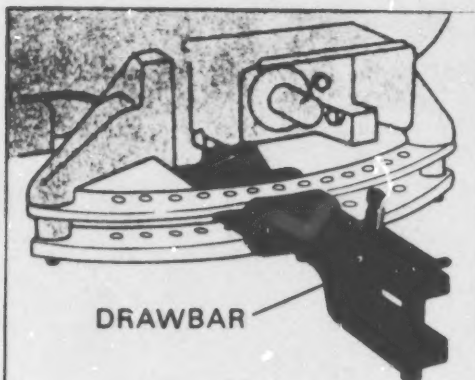
John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois

John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

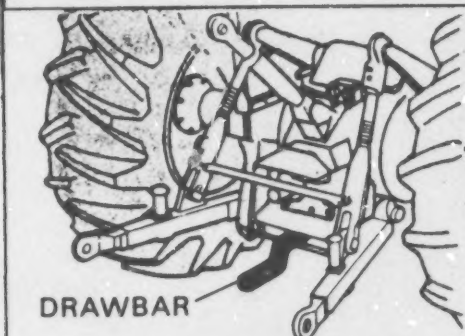


A 38-cm (15-inch) drawbar height is commonly used.

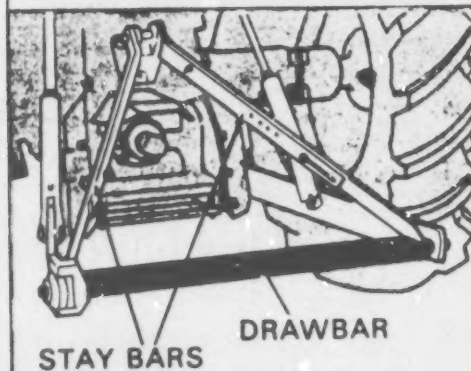
A TRACTOR MAY HAVE A DRAWBAR ONLY, A
DRAWBAR MOUNTED AS PART OF A 3-POINT HITCH
OR SEPARATE DRAWBAR AND 3-POINT HITCH.



DRAWBAR ONLY

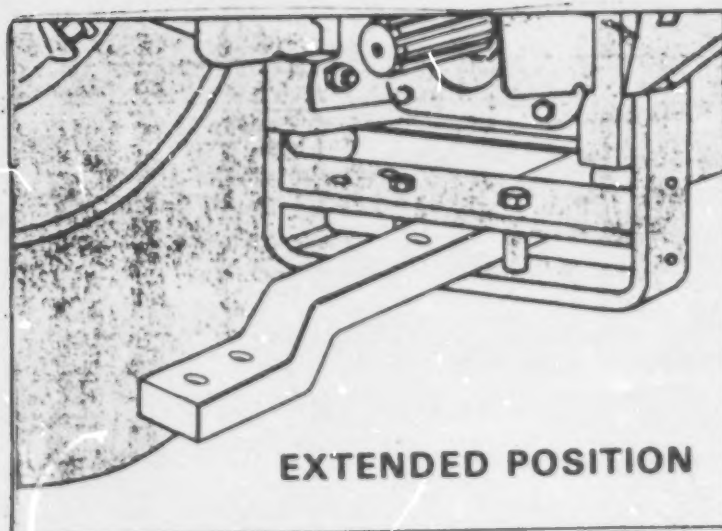
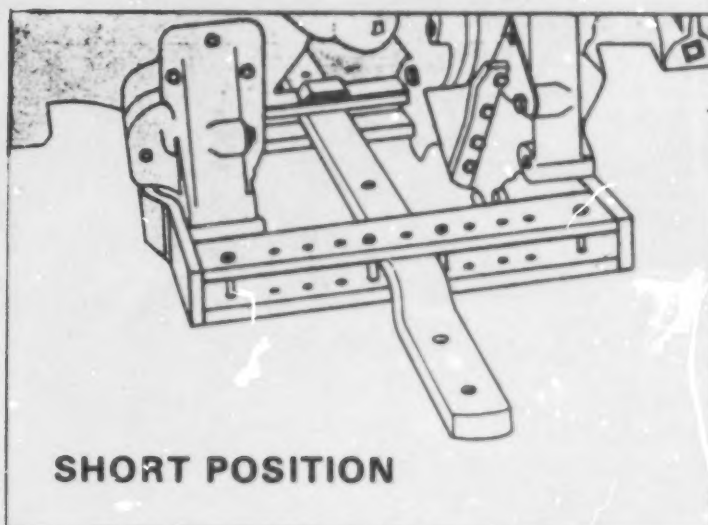


**DRAWBAR AND
THREE-POINT HITCH**

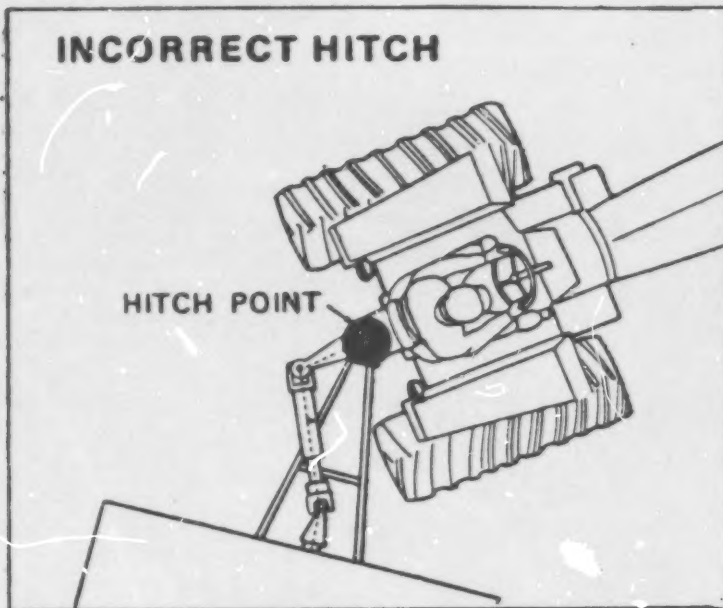
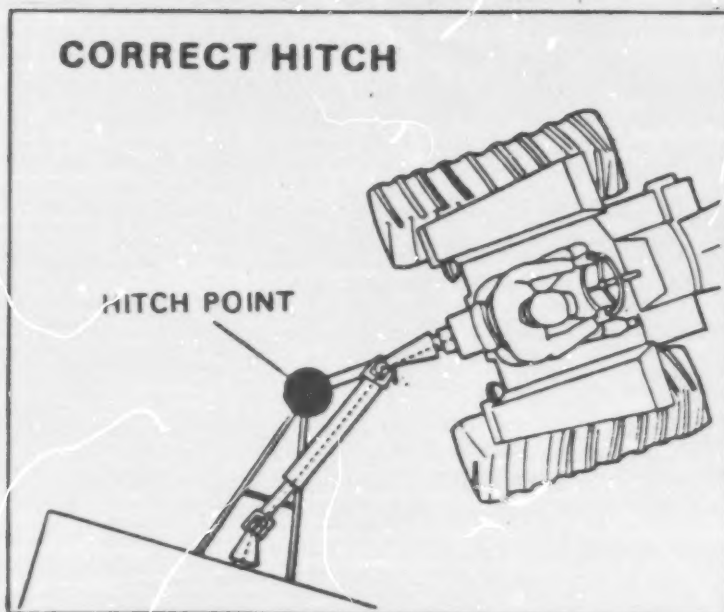


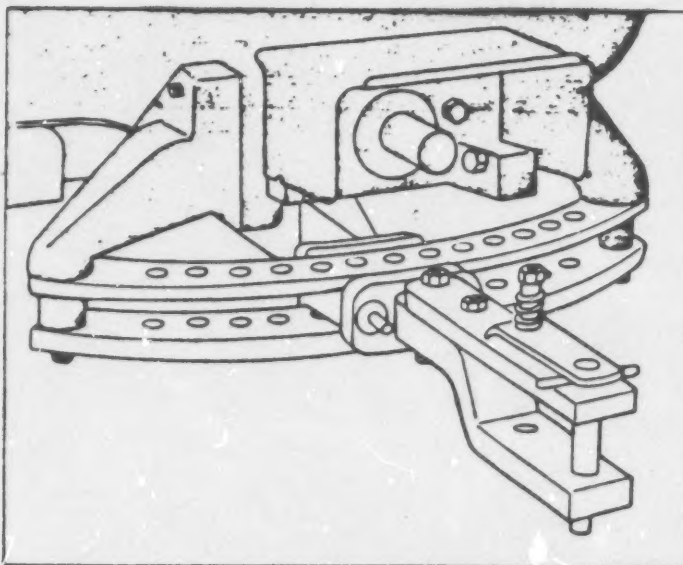
**DRAWBAR AS
THREE-POINT HITCH**

USE DRAWBAR IN SHORT POSITION FOR EQUIPMENT NOT
REQUIRING A PTO CONNECTION. EXTEND DRAWBAR FOR
POWER TAKE-OFF HOOKUP.



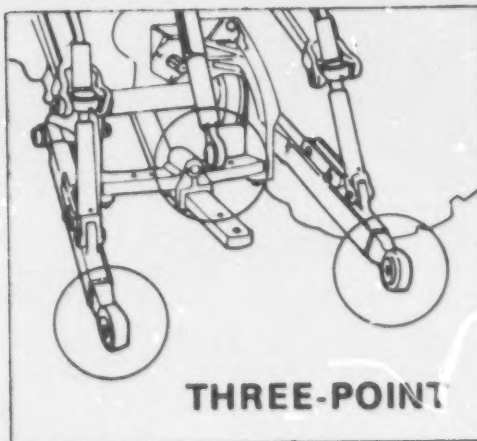
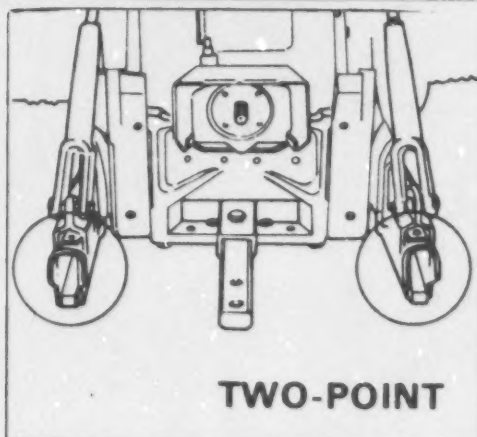
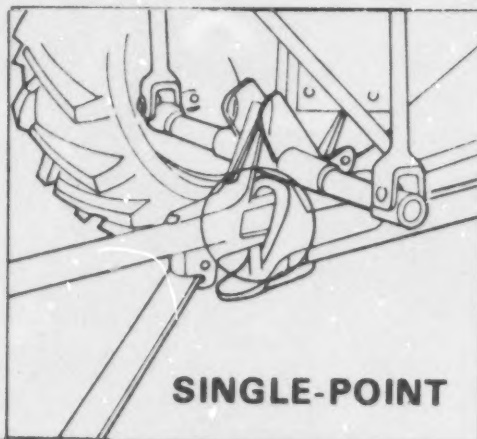
WITH SHORT DRAWBAR HITCH, POWER SHAFT BINDS OR LOCKS ON SHORT TURNS. WITH PROPER DRAWBAR HITCH, POWER SHAFT CAN CONTINUE TO OPERATE ON SHORT TURNS.

INCORRECT HITCH**CORRECT HITCH**



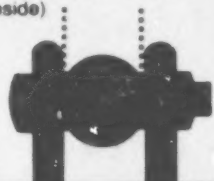
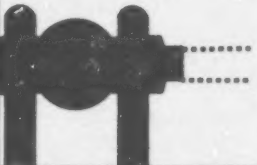
Some drawbars are made so that they can swing freely when pulling heavy loads. A swinging drawbar makes a tractor easier to steer.

TYPES OF INTEGRAL (REAR-MOUNTED, HYDRAULICALLY CONTROLLED) HITCHES.

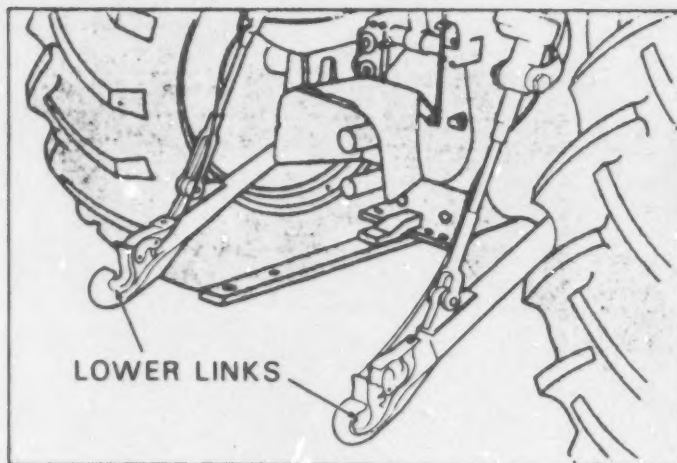


FOUR CATEGORIES OF IMPLEMENT ATTACHMENTS DESIGNED FOR STANDARD THREE-POINT HITCHES. NOTE DIFFERENCES IN MEASUREMENTS.

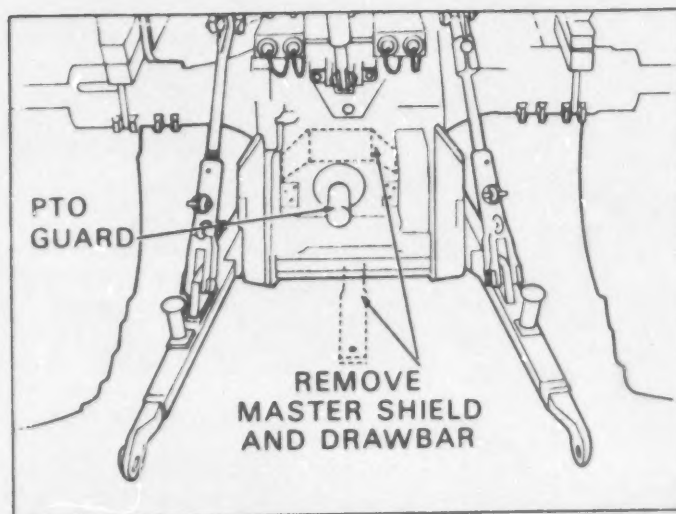
CATEGORY	MAXIMUM DRAWBAR POWER	
	KW	HP
I	15 TO 35	20 TO 40
II	30 TO 75	40 TO 100
III	60 TO 168	80 TO 225
IV	135 TO 300	180 TO 400

Ball Mast Width Upper Hitch Point Width (Inside) 	Stud Diameter 					
	Cat.	cm	in	Cat.	cm	in
	I	4.4	1¾	I	2.2	7/8
	II	5.2	2⅛	II	2.8	1⅛
	III	5.2	2⅛	III	3.7	1½
	IV	6.4	2½	IV	5.1	2

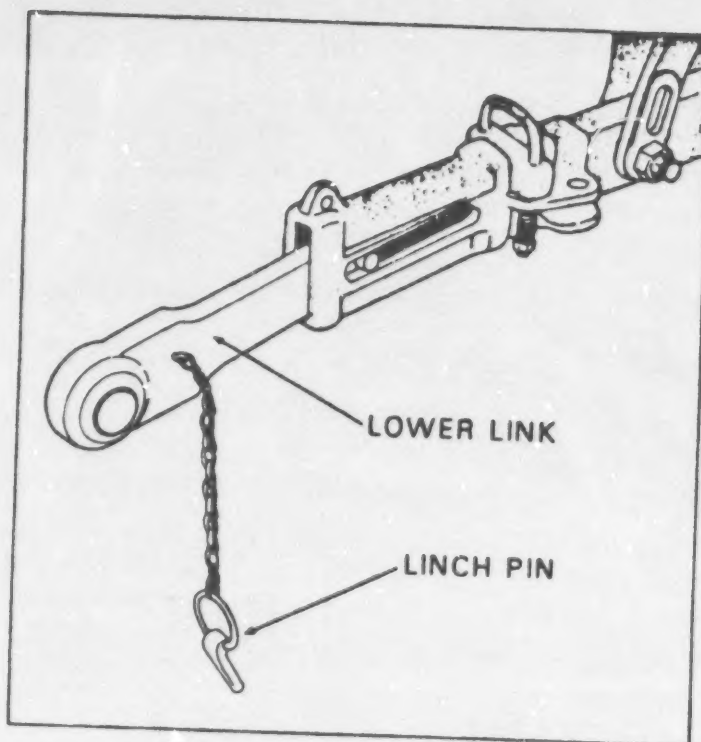
Hitch Pin Diameter 	Lower Hitch Spread 					
	Cat.	cm	in	Cat.	cm	in
	I	1.9	¾	I	68.3	26⅞
	II	2.5	1	II	82.5	32½
	III	3.2	1¼	III	96.5	38
	IV	4.5	1¾	IV	116	46



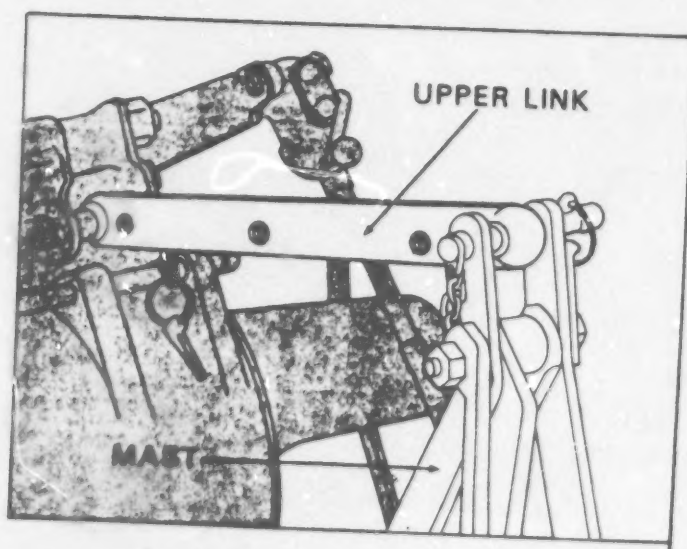
Lower links equipped with latches for quick attachment of equipment.



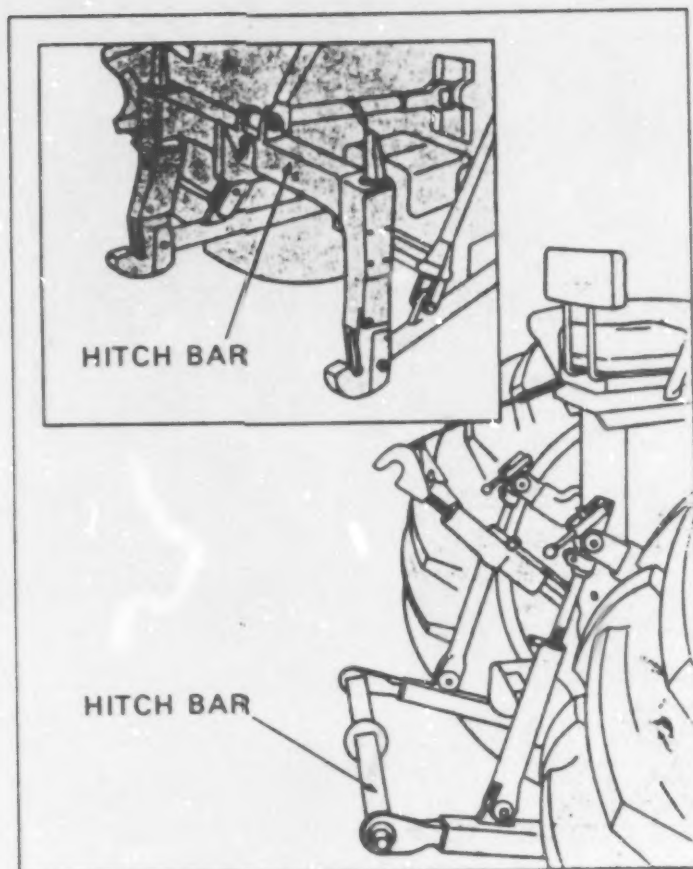
With some tractors, the drawbar must be shortened or removed when using the three-point hitch. The master shield over the power take-off shaft may also have to be removed, but be sure shaft is covered by tubular guard, cap or other protection.



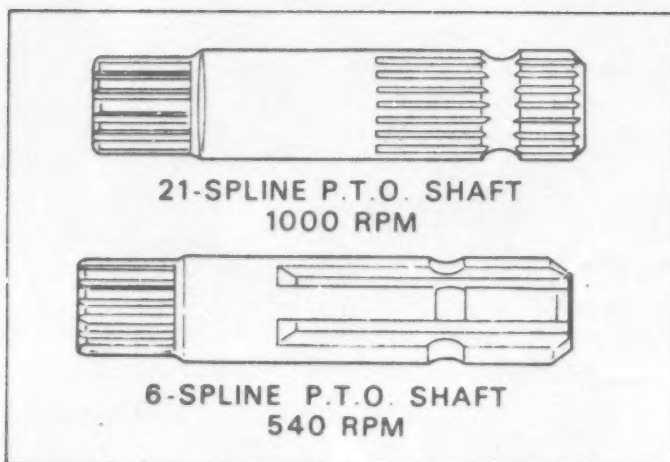
LOWER LINK WITH PROVISION FOR EXTENDING
FOR EASY CONNECTION TO IMPLEMENT.



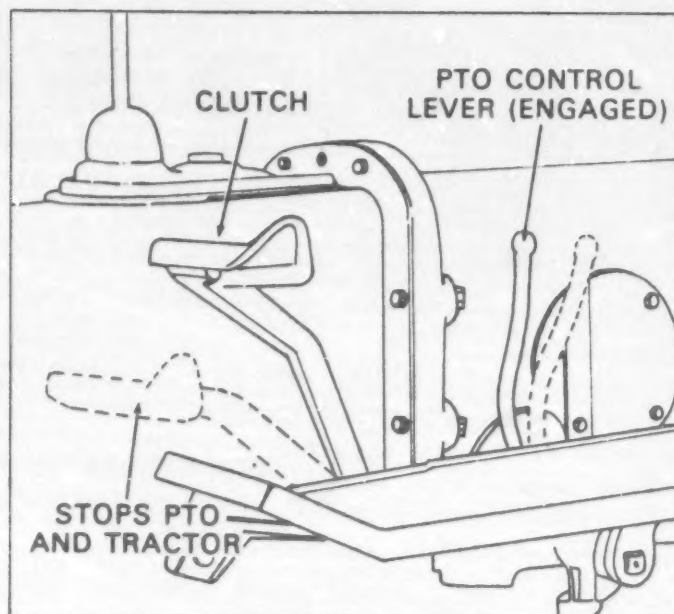
UPPER LINK CONNECTION TO IMPLEMENT MAST.



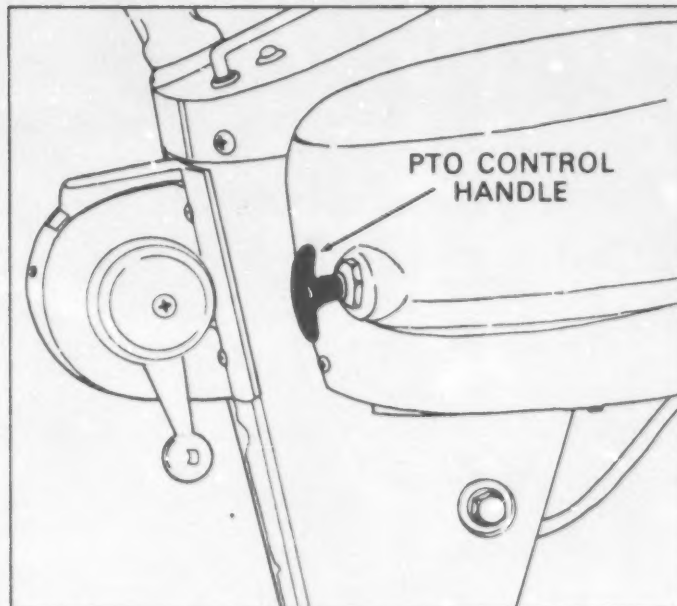
Hitch bar used for attaching some implements. (Inset) Quick coupler attachment provided for some tractors.



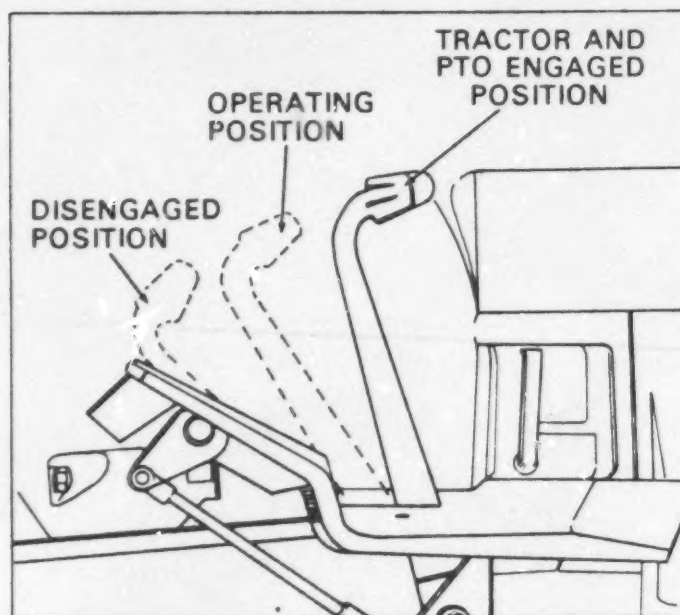
PTO shafts for 1,000 rpm have 21 splines on the end where the implement connects. Those for 540 rpm have 6 splines.



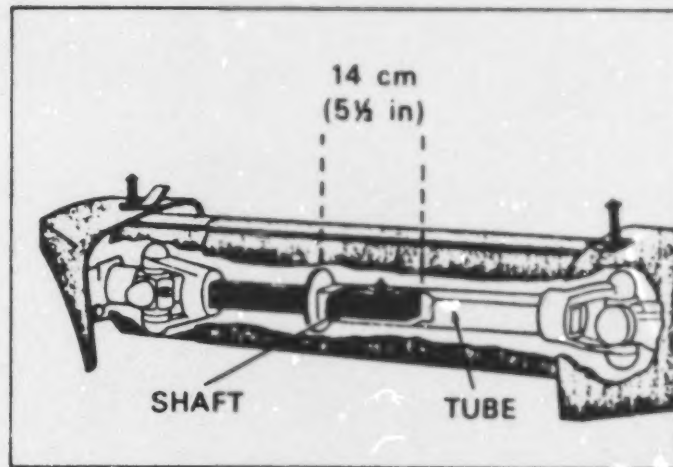
Transmission-driven PTO. Clutch engages (or disengages) power shaft and transmission shaft at same time.



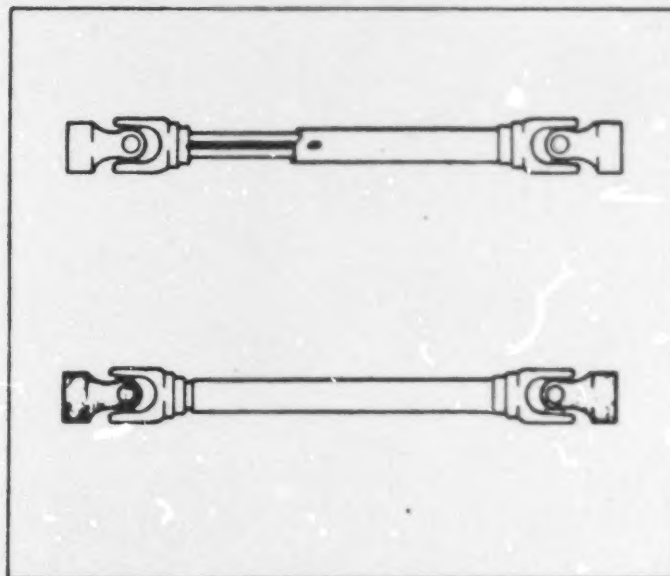
Independent power shaft controlled by separate hand control. Power shaft operates independently of ground movement of tractor.



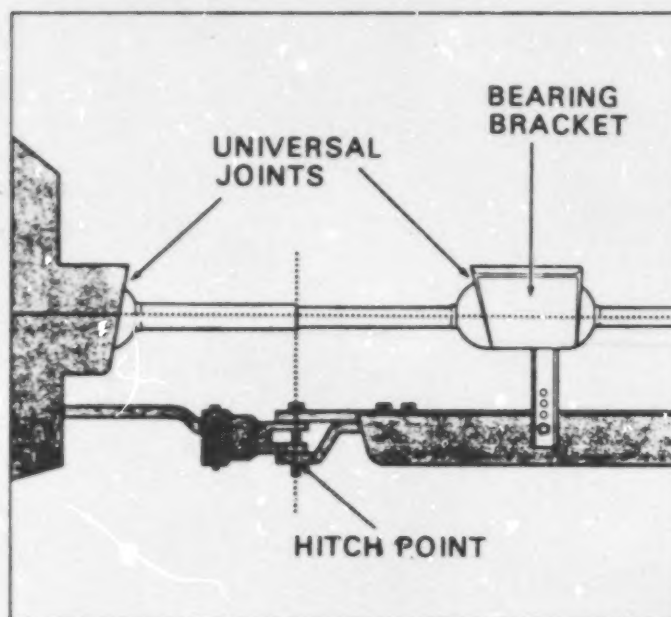
The continuous running PTO shaft is controlled by double-acting clutch. With clutch $\frac{1}{2}$ depressed, tractor movement stops but power shaft runs. With clutch completely depressed, both shafts are disconnected. With clutch completely engaged, power is supplied to both shafts.



Telescoping arrangement on implement drive shaft provides for lengthening and shortening. There should be at least 14 cm (5½ ins) of shaft length extending into tube (with tractor and implement on level ground and both in a straight line) to be certain shafts won't separate when rear wheels of tractor pass over a ridge.

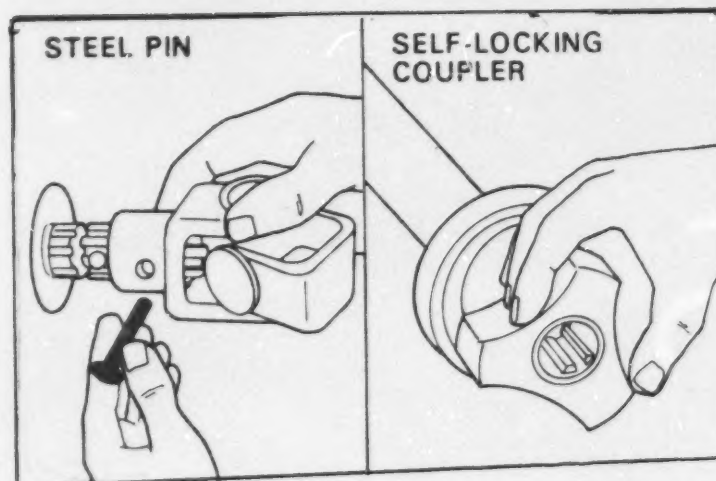
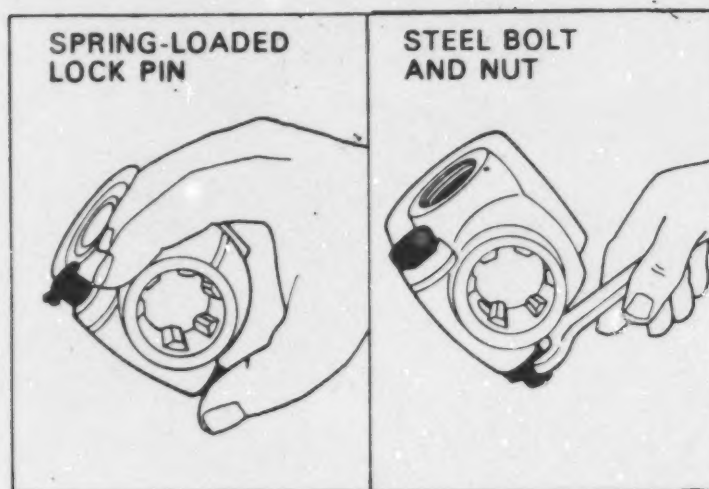


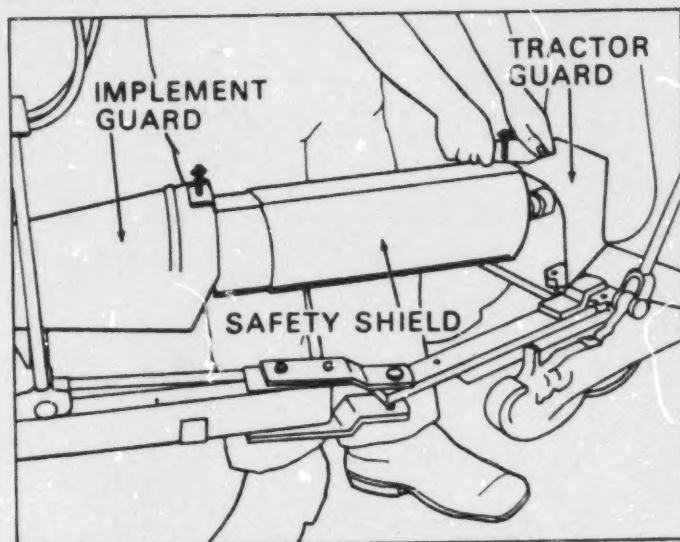
Most separable drive shafts are constructed with a bead and groove or other device, to assure correct assembly if they come apart. Shafts without such provision must be assembled so that both end yokes are in the same plane.



Adjust bearing bracket so PTO shaft is straight. Make sure hitch point is centered between universal joints.

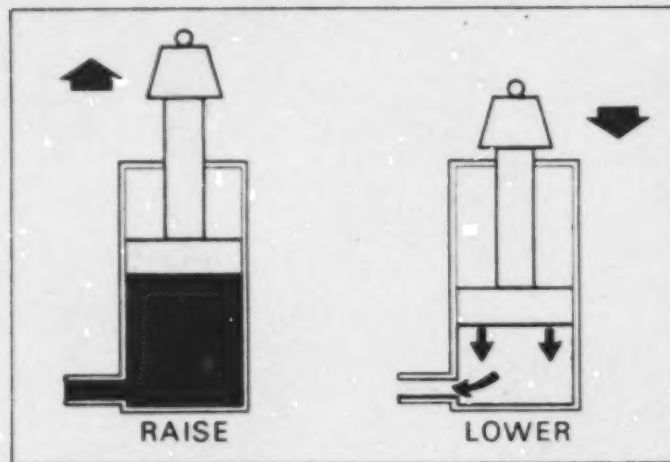
MEANS PROVIDED FOR HOLDING IMPLEMENT POWER SHAFT TO
TRACTOR PTO SHAFT.



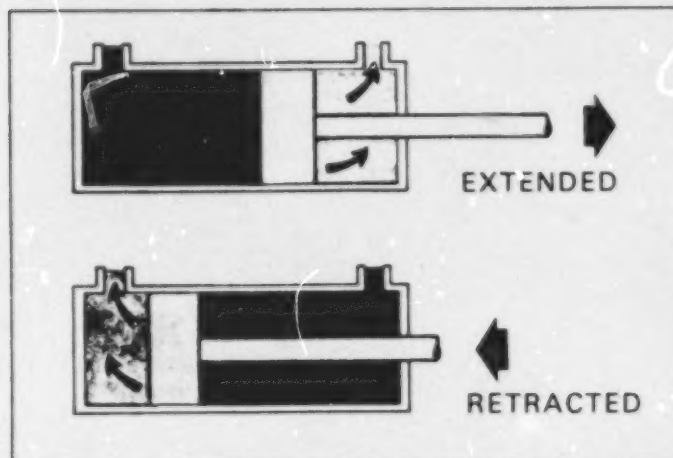


Be sure safety shield is fastened securely to the implement guard and to adapter guard on tractor.

HYDRAULIC CYLINDERS

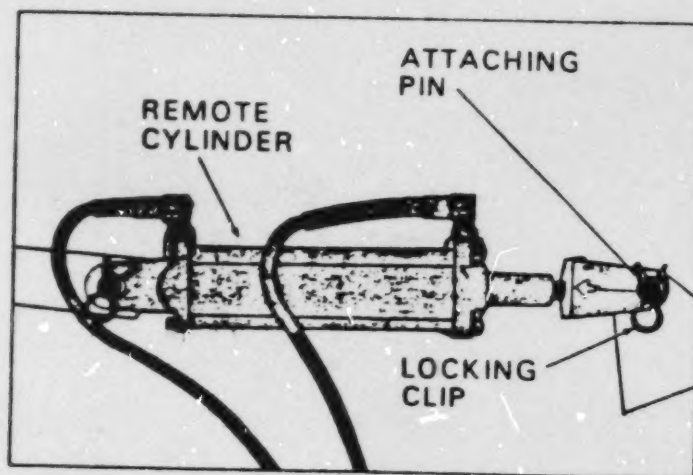


Working principle of a single-acting (closed-center) hydraulic system.



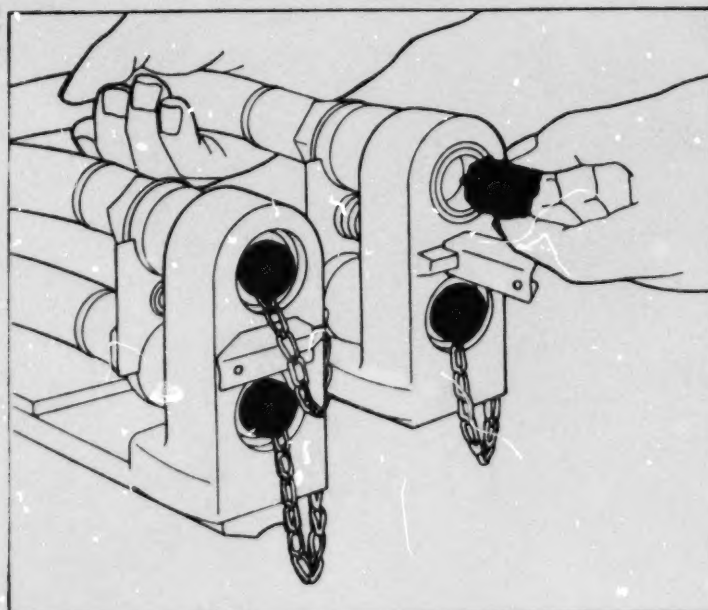
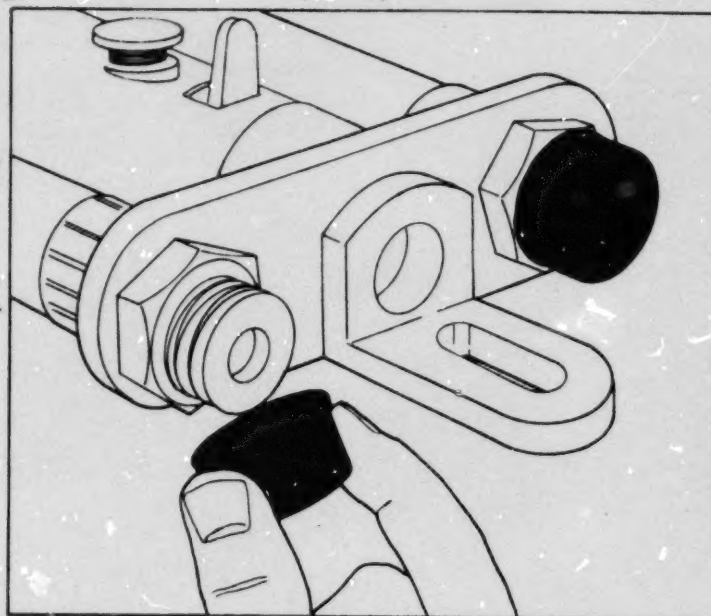
Working principle of a double-acting (open-center) hydraulic system.

REMOTE CYLINDER



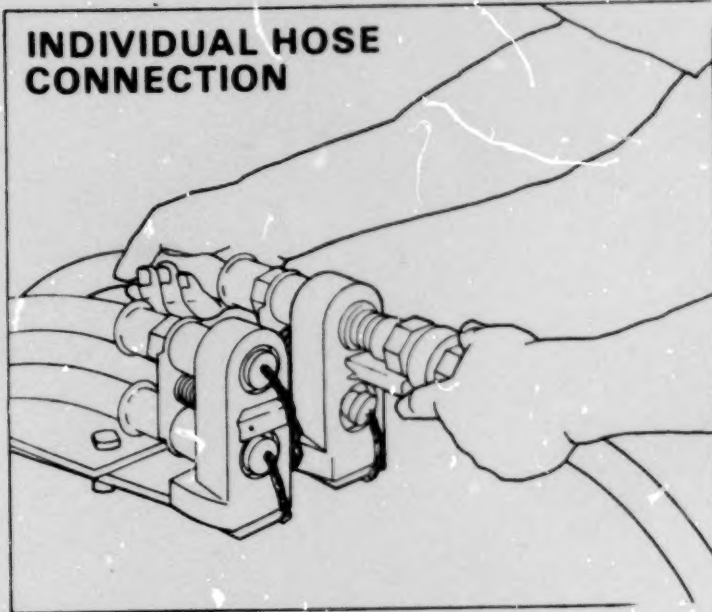
Remote cylinder is held at both ends with attaching pins. Attaching pins are held in place with spring locking clips.

TYPES OF HYDRAULIC-COUPLING DUST PROTECTORS

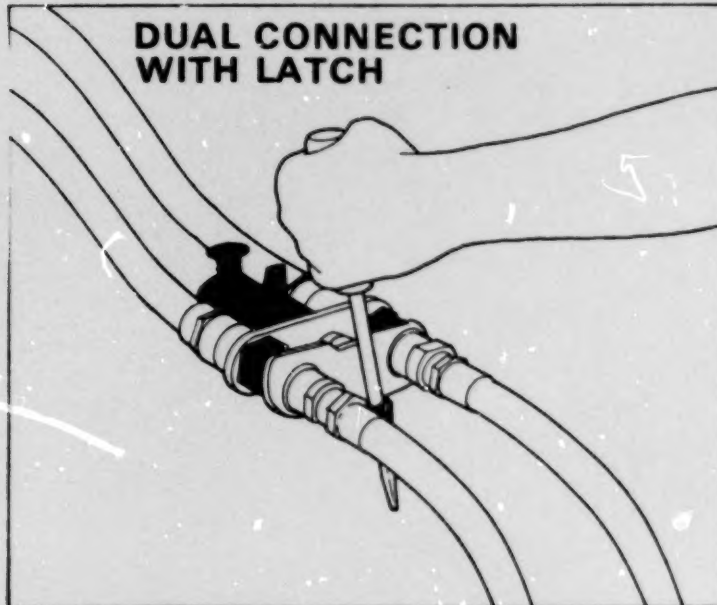


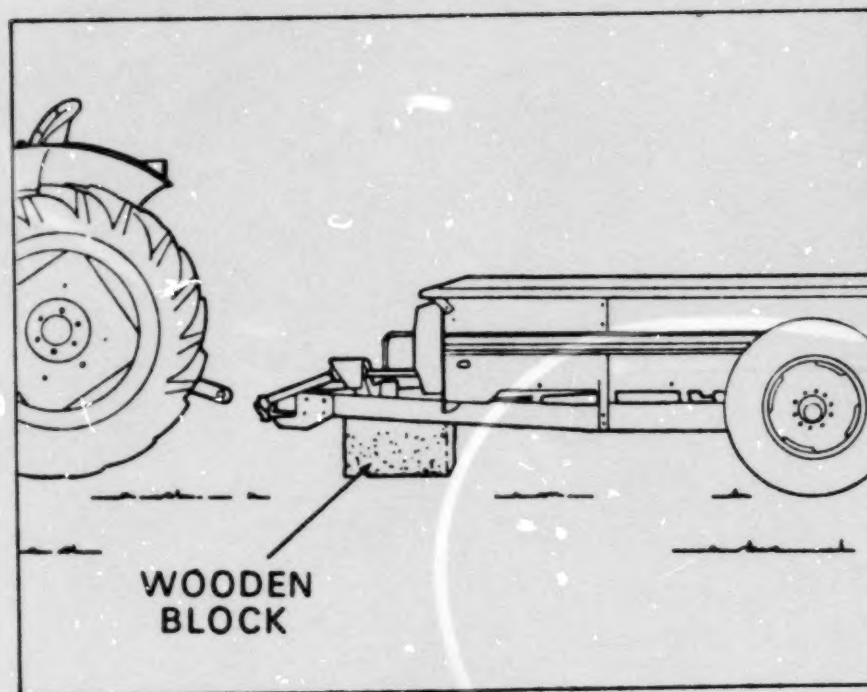
BREAK-AWAY TYPES OF HOSE COUPLINGS

INDIVIDUAL HOSE CONNECTION



DUAL CONNECTION WITH LATCH





Rest implement on wood block for easy re-connection.

WORKSHEET #1

TRACTOR HITCHES, PTO AND HYDRAULICS

The activities on this worksheet may be completed by referring to a tractor operator's manual or a tractor.

1. Drawbar

- a. Can drawbar swing? _____
- b. Length adjustments possible _____
- c. Size of pin to be used _____
- d. Correct length for PTO operation _____

2. 3-Point Hitch

- a. Category _____
- b. Size of attaching pins _____
- c. Horsepower rating _____
- d. How is side-swing controlled? _____
- e. Equipped with draft arm extensions? _____
- f. Equipped with latches which secure or release implement? _____
- g. How is lateral adjustment made? _____
- h. Equipped with load sensing device? _____
- i. Equipped with depth sensing device? _____
- j. How many hydraulic control levers are used for the 3-point hitch? _____

3. Remote Hydraulic Motors and Cylinders

- a. How are attaching pins secured? _____
- b. Cylinders have a stop device? _____
- c. If a stop device is used, how is it adjusted? _____
- d. Length between centers of attaching pins (ram retracted)? _____
- e. Are hydraulic lines fitted with couplers? _____
If so, how do the couplers work? _____
- f. What will happen to dirt or dust which is not removed before connecting hydraulic couplers? _____
- g. List the hydraulic operations (like power steering etc.) which are constructed into the tractor (not remote operations) _____

- h. How many remote hydraulic units may be used with the tractor? _____
- i. Is an adjustment indicated for rate control of remote operations? _____
- j. Is the tractor equipped to use single- or double-acting cylinders? _____

4. PTO

- a. Master shield in place? _____
- b. Are both PTO speeds possible for the tractor? _____
 - (1) If so, how is the PTO speed changed? _____
 - (2) How many teeth are on the PTO spline(s)? _____

UNIT: Tractor and Machinery Safety

Lesson: Farm Machinery Accident Situations

Need:

Most tractor and machinery accidents are caused by human error. Understanding how accidents can happen is the first step that must be taken to prevent accidents.

Objective:

Given pieces of equipment; such as wagons, loaders, elevators or augers, grinder mixers, balers, combines, haying equipment, planters, sprayers, cultivators, and plowing equipment; each student will be able to identify and discuss situations where accidents could possibly occur.

Interest Approach:

Show overheads of farm accidents or discuss a particular story (local) discuss an accident which could have been prevented.

Key questions, problems,
concerns

Teaching techniques and
information

- | | |
|---|---|
| 1. Why accidents happen. | a. Discuss each of the following: <ol style="list-style-type: none">1. Poor attitude2. Children near operating machines3. Incorrect clothing4. Poor communication between operators5. Fatigue6. Poor housekeeping7. Too big of a hurry8. Improper use and maintenance of machinery9. Improper use of tools during repairs10. Lack or misuse of safety devices11. Lack of training |
| 2. Situations which surround equipment and machinery causing accidents. | <ol style="list-style-type: none">a. Human error is the major problem when discussing situations which cause accidents. (See Overhead #1)b. Have students complete farm machinery accident situations worksheet #1. (Unit 9 - Farm Machinery Accident Situations, Hobar Student Manual.)c. Discuss those situations which involve:<ol style="list-style-type: none">1. Fencing2. Wagons |

3. Tractor loaders
4. Elevators and augers
5. Grinder-mixers
6. Baler
7. Large round baler
8. Combine
9. Haying equipment
10. Windrower
11. Planters
12. Sprayers
13. Cultivators
14. Disk harrow
15. Spike tooth harrow
16. Plow
17. Any other equipment found in local areas

Application and Followup:

1. Visit a farm or ranch and discuss situations which could possibly cause farm accidents.
2. Conduct a farm machinery safety survey.
3. Have students complete "Why Farm Machinery Accidents Occur" -- worksheet #2, Unit 8 Hobar Student Manual.

References:

AAVIM, Safe Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, Athens, Georgia, 1981.

Sillette and Hull, Safe Operation of Agricultural Equipment, Hobar Publications, St. Paul, MN.

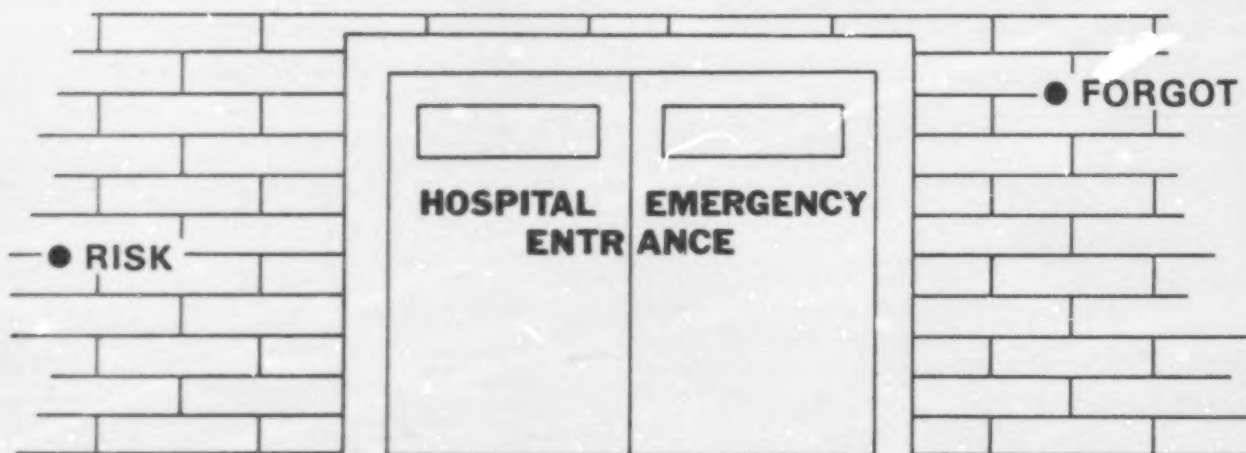
John Deere Equipment Company, "Fundamentals of Machinery Operation - Instructor's Kit", Moline, Illinois

John Deere Equipment Company, "Fundamentals of Machinery Operation - Agricultural Machinery Safety", Moline, Illinois

HUMAN MISTAKES LEAD TO INJURY

● UNSAFE
PRACTICE

● FAILED TO RECOGNIZE



● TOOK SHORTCUT

● PREOCCUPATION

WORKSHEET #1

FARM MACHINERY ACCIDENT SITUATIONS

Discuss the following.

1. Why should one not touch a hydraulic *pinhole* leak with gloves or bare hands?

2. What would you suggest as a safe way to find a hydraulic line pinhole leak?

3. How might the following human errors cause an accident in machinery operation?

Give examples.

a. Hazard not recognized

b. Warning ignored

c. Operator preoccupied

4. Most self-propelled machines have a *blind* area immediately around the machine. How could this result in an accident?

5. What suggestions could be made to avoid accidents within the blind area around a self-propelled machine?

6. What can be done during the year to make fields less hazardous during harvest time (stumps, stones, ditches, weeds, etc.)?

7. The purposes of this unit are to (1) show that accidents can happen and (2) alert readers to some situations in which human error leads to an accident. What main conclusions can be made about farm machinery accidents?

WORKSHEET #2

WHY FARM MACHINERY ACCIDENTS OCCUR

1. How many Iowa farm deaths were due to falls from tractors as reported in table 8-1? _____
2. Refer to your collection of farm accident reports. What causes of farm machinery accidents can you identify for the accidents?

3. In your own words, explain the phrase, "a correct safety attitude."

4. What is done on your farm to reduce injuries due to machine operator fatigue?

5. Do your neighbors allow small children to ride on tractors or on machinery?

6. An Iowa farmer's wife allows her 3-year-old son to ride in the cab of the tractor because "It is a safe place for him to ride." Do you agree with her?

7. Describe the condition of tools that are carried in your farm tractors as Excellent, Good, or Need Improvement.

8. Do you plan to teach your parents or employer the hand signals for tractor operation?

9. How is the physical well-being of a machine operator important?

